

REMARKS

This communication responds to the Office Action mailed on August 17, 2007. Claims 1, 7, 24, 29 are amended, no claims are canceled, and no claims are added; as a result, claims 1-11, 24-34, and 39-42 are now pending in this application.

Double Patenting Rejection

Claims 1-11, 24-34, and 39-42 were provisionally rejected under non-statutory obviousness-type doctrine of double patenting as being unpatentable over claims 13-16, 19-20, and 23-24 of co-pending Application No. 11/494,056.

Applicant does not admit that the claims are obvious in view of co-pending Application No. 11/494,056. However, a Terminal Disclaimer in compliance with 37 C.F.R. 1.321(b)(iv) will be considered upon indication of allowance of the claims.

§103 Rejection of the Claims

Claims 1-4, 7-11, 24-34, and 39-41 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu ('078) in view of Szejewski ('499). Applicant respectfully traverses this rejection.

Liu has been previously discussed and discloses a first photoresist mask 106 to etch a first pattern 108 in an amorphous carbon hard mask 104 and removing the first photoresist 106 (see figure 2C) by a plasma process with no indication or discussion of residual photo resist problems. A second photoresist mask 110 is used to etch a second pattern 112 on the same hard mask 104 and plasma removing the second photoresist (see figure 2E), again with no disclosure or suggestion of any possible residual photo resist issue. The combination pattern in the hard mask 104 of the first and the second masks (108 and 114) is used to etch a pattern 116 into the substrate 102.

Applicant respectfully submits that there is no suggestion in Liu of a problem with residual photoresist, and Liu does not suggest treating the surface of the substrate to remove residual resist under conditions that are selective to the hard mask and to the substrate, since there is no discussion of residual resist in Liu, or even any recognition of such an issue existing.

This deficiency in Liu was recognized by the Office in the prior Office Action dated May 2, 2007 on page 5, in the second paragraph. Applicant thus respectfully submits that Liu provides no motivation for one of ordinary skill in the art to make the suggested combination of references.

Szwejkowski discloses removing a silicon and oxide containing sidewall material 26 which inadvertently formed during polysilicon anisotropic etch of the polysilicon layer 20 to form polysilicon line 28 (see col. 1, lines 32-42, and col. 2, lines 4-11, to show that sidewall material 26 is not a residual portion of the photoresist 32, or organic polymer material). Thus, Applicant respectfully submits the material 26 would not be understood by one of skill in the art to be a photo resist.

Applicant further submits that sidewall material 26 is removed by HF, being formed of silicon and oxides (see col. 2, lines 29-38; col. 3, lines 5-11) and "not purely polysilicon" (see col. 3, line 8). Applicant further submits that the disclosed removal methods, such as HF etching, would clearly imply removing a dielectric material to one of ordinary skill in the art, and not residual photoresist. Therefore, Applicant maintains that the cited reference does not teach or suggest removing organic photo resist.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of "...*surface treating the substrate to remove residual resist disposed in contact with at least one of the top surface of the hard mask and the substrate under conditions that are selective to the hard mask and to the substrate...*", as recited in independent claim 1, as amended herein, from which claims 2-6 depend. Neither reference suggests an organic photoresist residue, nor a residue on the hard mask, nor a residue in contact with the substrate.

For similar reasons, Applicant respectfully submits that the remaining independent claims are also patentable over the suggested combination of references. The dependent claims are believed to be patentable at least as depending from patentable base claims as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the above noted claim amendments, and discussion of the failure of the references to describe or suggest at least removing residual photoresist in contact with the

substrate, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 5-6, 11, 25-29, and 31-34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) as applied to claims 1-4, 7-11, 24-34, and 39-41 above, and further in view of Chen ('435). Applicant respectfully traverses this rejection.

Liu discloses two different photoresist masks 106 and 110 to etch a first pattern 108 and then a second pattern 112 in an amorphous carbon hard mask 104. The photoresist layers are each removed after each etch by a plasma process with no indication or discussion of residual photo resist problems. The combination pattern in the hard mask 104 of the first and the second masks (108 and 114) is used to etch a pattern 116 into the substrate 102. There is no suggestion in Liu of a problem with residual photoresist, nor treating the surface of the substrate to remove residual resist, nor any recognition of such an issue existing, and therefore, Liu can not provide motivation for one of ordinary skill in the art to obtain the present claimed arrangement.

Szwejkowski discloses removing a silicon and oxide containing sidewall material 26, which is not a residual portion of the photoresist 32, nor an organic polymer material. The sidewall 26 is removed by HF since it is formed of silicon and oxides (see col. 2, lines 29-38; col. 3, lines 5-11) and "not purely polysilicon" (see col. 3, line 8) – it is not a photoresist residue. Applicant respectfully submits that the cited reference does not teach or suggest removal of organic photo resist.

Chen is used in the outstanding Office Action to show that solutions of ammonium hydroxide and peroxide are known. Applicant respectfully submits that the addition of Chen does nothing to cure the above noted failure of the other references to teach or suggest a surface treatment to remove residual photo resist material.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of "*...surface treating the substrate to remove residual resist disposed in contact with at least one of the top surface of the hard mask and the substrate under conditions that are selective to the hard mask and to the substrate...*", as recited

in independent claim 1, as amended herein, from which claims 5-6 depend. Neither reference suggests a photoresist residue, nor a photoresist residue in contact with the substrate.

For similar reasons, Applicant respectfully submits that the remaining independent claims are also patentable over the suggested combination of references. The dependent claims are believed to be patentable at least as depending from patentable base claims as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the above noted claim amendments, and discussion of the failure of the references to describe or suggest at least removing residual photoresist, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claim 42 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) as applied to claims 1-4, 7-11, 24-34, and 39-41 above, and further in view of Fang ('338). Applicant respectfully traverses this rejection.

Liu discloses two different photoresist masks 106 and 110 to etch a first pattern 108 and then a second pattern 112 in an amorphous carbon hard mask 104. The photoresist layers are each removed after each etch by a plasma process with no indication or discussion of residual photo resist problems. The combination pattern in the hard mask 104 of the first and the second masks (108 and 114) is used to etch a pattern 116 into the substrate 102. There is no suggestion in Liu of a problem with residual photoresist, nor any sort of substrate surface treatment to remove residual resist, nor any recognition of such an issue existing, and Liu can not therefore provide motivation for one of ordinary skill in the art to obtain the present claimed arrangement.

Szwejkowski discloses removing a silicon and oxide containing sidewall material 26, which is not a residual portion of the photoresist 32, nor an organic polymer material. The sidewall 26 is removed by HF, since it is formed of silicon and oxides (see col. 2, lines 29-38; col. 3, lines 5-11) and "not purely polysilicon" (see col. 3, line 8) – it is not a photoresist residue. Applicant respectfully submits that the cited reference does not teach or suggest removal of organic photo resist.

Fang is used in the outstanding Office Action to show that it is known to use solutions including sulfuric acid and citric acid. Applicant respectfully submits that the addition of Fang

does nothing to cure the above noted failure to suggest a surface treatment to remove residual photo resist material.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*patterning a carbon-containing hard mask over a substrate with a photoresist; removing the photoresist; surface treating the substrate to remove residual photoresist in contact with the substrate under conditions that are selective to the hard mask and to the substrate; and dry etching the substrate through the hard mask...*”, as recited in independent claim 39, from which claim 42 depends. The cited references, whether taken alone or in any combination, do not suggest a surface treatment to remove residual photoresist or photoresist in contact with the substrate. Thus, the suggested combination of references, even if there were proper motivation shown to make the combination, still does not suggest at least the above recited feature of the claims.

The dependent claim is believed to be patentable at least as depending from a patentable base claim, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the above noted claim amendments, and discussion of the failure of the references to describe or suggest at least removing residual photoresist, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Reservation of Rights

In the interest of clarity and brevity, Applicant may not have equally addressed every assertion made in the Office Action, however, this does not constitute any admission or acquiescence. Applicant reserves all rights not exercised in connection with this response, such as the right to challenge or rebut any tacit or explicit characterization of any reference or of any of the present claims, the right to challenge or rebut any asserted factual or legal basis of any of the rejections, the right to swear behind any cited reference such as provided under 37 C.F.R. § 1.131 or otherwise, or the right to assert co-ownership of any cited reference. Applicant does not admit that any of the cited references or any other references of record are relevant to the present claims, or that they constitute prior art. To the extent that any rejection or assertion is based upon the Examiner's personal knowledge, rather than any objective evidence of record as manifested by a cited prior art reference, Applicant timely objects to such reliance on Official

Notice, and reserves all rights to request that the Examiner provide a reference or affidavit in support of such assertion, as required by MPEP § 2144.03. Applicant reserves all rights to pursue any cancelled claims in a subsequent patent application claiming the benefit of priority of the present patent application, and to request rejoinder of any withdrawn claim, as required by MPEP § 821.04.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney at (210) 308-5677 to facilitate prosecution of this application. If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
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Minneapolis, MN 55402
(210) 308-5677

Date November 15, 2007

By Mark V. Muller
Mark V. Muller
Reg. No. 37,509

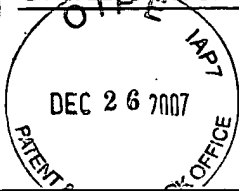
CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: MS Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 19th day of November, 2007.

Amy Moriarty
Name

[Signature]
Signature



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APPLICATION NO.	FILED DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/788,889	02/27/2004	Kevin Shea	303.867US1	4555

21186 7590 07/10/2007
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EXAMINER

SULLIVAN, CALEEN O

ART UNIT PAPER NUMBER

1756

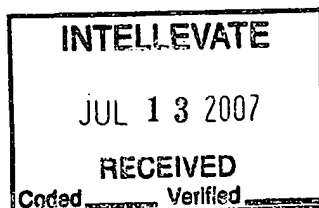
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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

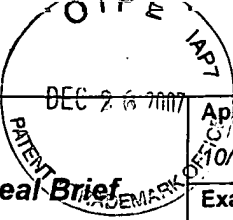


Schwegman Lundberg
Woessner & Kluth P.A.

JUL 13 2007

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**Advisory Action
Before the Filing of an Appeal Brief**



Application No.

10/788,889

Applicant(s)

SHEA ET AL.

Examiner

Caleen O. Sullivan

Art Unit

1756

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 28 June 2007 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

1. ☒ The reply was filed after a final rejection, but prior to or on the same day as filing a Notice of Appeal. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114. The reply must be filed within one of the following time periods:

- a) ☐ The period for reply expires _____ months from the mailing date of the final rejection.
b) ☒ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

Examiner Note: If box 1 is checked, check either box (a) or (b). ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☒ The proposed amendment(s) filed after a final rejection, but prior to the date of filing a brief, will not be entered because
(a) ☒ They raise new issues that would require further consideration and/or search (see NOTE below);
(b) ☐ They raise the issue of new matter (see NOTE below);
(c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
(d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

NOTE: See *Continuation Sheet*. (See 37 CFR 1.116 and 41.33(a)).

4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).
7. ☒ For purposes of appeal, the proposed amendment(s): a) ☒ will not be entered, or b) ☐ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.
The status of the claim(s) is (or will be) as follows:
Claim(s) allowed: _____.
Claim(s) objected to: _____.
Claim(s) rejected: 1-42.
Claim(s) withdrawn from consideration: _____.

AFFIDAVIT OR OTHER EVIDENCE

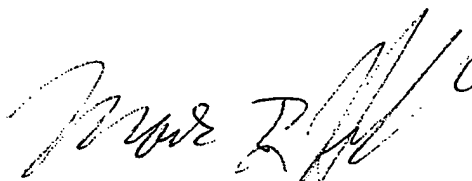
8. ☐ The affidavit or other evidence filed after a final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing of good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

11. ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because:
See *Continuation Sheet*.
12. ☐ Note the attached Information Disclosure Statement(s). (PTO/SB/08) Paper No(s). _____.
13. ☐ Other: _____.

Continuation of 3. NOTE: Applicant has amended claims 1 and 39 to include the limitation that the residual resist removed is disposed in contact with the substrate; however the amendment will not be entered. If the aforementioned amendment to claims 1 and 39 had been entered the rejection presented in the previous Office Action would still apply because the combination of Liu ('078) and Szejewski ('499) does contemplate the limitation added by Applicant's amendment of claims 1 and 39. Applicant's amendment to claim #39 to include the limitation that the photoresist layer over the hard mask layer is removed, will not be entered. However if the amendment had been entered the rejection presented in the previous Office Action would still apply because the combination of Liu ('078) and Szejewski ('499) teaches this limitation.

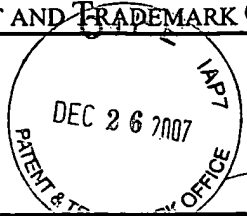
Continuation of 11. does NOT place the application in condition for allowance because: Applicant's arguments are drawn to the unentered amendment of claims 1 and 39.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/788,889

02/27/2004

Kevin Shea

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4555

21186 7590 05/02/2007

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MINNEAPOLIS, MN 55402

EXAMINER

SULLIVAN, CALEEN O

ART UNIT

PAPER NUMBER

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DELIVERY MODE

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PAPER

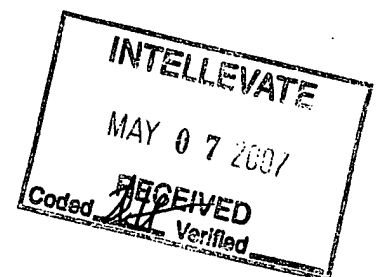
Please find below and/or attached an Office communication concerning this application or proceeding.

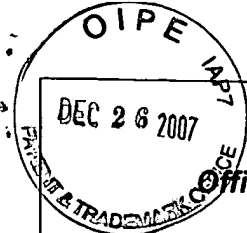
The time period for reply, if any, is set in the attached communication.

Schwegman Lundberg
Woessner & Kluth P.A.

MAY 07 2007

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Office Action Summary

Application No. 10/788,889	Applicant(s) SHEA ET AL.	
Examiner Caleen O. Sullivan	Art Unit 1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03/09/2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-42 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-42 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 March 2007 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

1. Applicant's amendments to the Specification have overcome the Examiner's objection; therefore the objection to the specification is withdrawn.
2. Applicant has submitted a new set of corrected drawings, which are accepted by the Examiner; therefore the objection to the drawings is withdrawn.
3. Applicant has amended claims 3-6, 10-38 and 42 in response to the rejection of these claims under 35 USC 112 2nd paragraph. The amendment to the claims has overcome the rejection of these claims for the incorrect Markush group language used and for the use of a trademark in the claims; therefore, the rejections under 35 USC 112 2nd paragraph for incorrect Markush group language, and the use of a trademark in the claims are withdrawn. However, applicant has failed to overcome the rejection of claims 3-6, 10-38 and 42 under 35 USC 112 2nd paragraph for indefiniteness as well as the rejection of claims 3-6, 10-11, 14-20, 22-23, 31-34 and 42 under 35 USC 112 1st paragraph, for failure to define the concentration ratios; therefore, Examiner restates the grounds of rejection presented in the last Office Action in response to the amendments.
4. However, Applicant's amendments to the claims have not overcome the rejections under 35 USC 102(b) and 35 USC 101, presented in the last Office Action. Moreover, until a terminal disclaimer is offered the rejection of claims 1-11, 24-34 and 39-42 under non-statutory obviousness-type double patenting cannot be withdrawn. Therefore, Examiner restates the grounds of rejection presented in the last Office Action in response to the amendments.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or

Art Unit: 1756

with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 3-6, 10-11, 14-15, 16-20, 22-23, 31-34 and 42 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contain subject matter, which was not described in the specification. In the aforementioned claims applicant includes limitations specifying "concentration ratios" for the "surface treating solutions" used in the process of removing residual photoresist; however, applicant has failed to describe in the specification if these "concentration ratios" are volume, weight, or mole ratios. For the purpose of examination, Examiner has considered the "concentration ratios" to be volume ratios in the rejections that follow.

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 3-6, 10-38 and 42 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 3-6, 10-11, 14-20, 22-23, 31-34 and 42 include the term "concentration ratio;" however, it is unclear as to whether the concentration ratio is a volume, a weight, or a mole ratio. For the purpose of examination, Examiner has considered the "concentration ratio" to be a volume ratio in the rejections that follow.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Art Unit: 1756

8. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

9. Claims 1-4, 7-14, 16-21, 24-35, 37, and 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szejewski ('499).

Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch and then the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). This disclosure teaches the limitation of claim 1-2, 7, 9-11, 24, 29, and 39-41, where a carbon containing hard mask over a substrate with a resist is patterned, where patterning the hard mask includes patterning amorphous carbon, and where the substrate is then patterned by a dry etch method through the hard mask.

Liu ('078) also teaches the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56- col. 6, 45; Fig.3A-3F). This teaching meets the limitation of claims 12, 16, 21, 35 and 37 where an amorphous carbon hard mask that includes a resist stack is patterned. Moreover, this teaching meets the limitations of the

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aforementioned claims where the resist stack includes one ARC over the hard mask, which is selected from a dielectric anti-reflective coating (DARC) and a bottom anti-reflective coating (BARC), and a photoresist layer is over the at least one ARC.

However, Liu ('078) fails to teach a process step where the surface of the substrate is treated with a solution to remove residual resist under conditions that are not damaging to the underlying layers. Szejewski ('499) discloses a method, which teaches such process steps.

Szejewski ('499) discloses a method to remove sidewall residues remaining after a polysilicon layer that has been masked with a photoresist layer is etched. The residues from the etch process are removed without undercutting the remaining polysilicon, using a solution of ammonium hydroxide and peroxide. (See, col.2, 26-39 and 57-col.3,2). This disclosure teaches the limitation of claims 1-12, 14-16, 21, 24-29, 31-35, 37 and 40-41 where the substrate is treated with a solution of ammonium hydroxide and peroxide to remove residual resist under conditions that are not damaging to the underlying layers.

Szejewski ('499) also teaches the solution of aqueous hydrogen peroxide and ammonium hydroxide has a concentration ratio by volume of about 1 part hydroxide to 2 parts peroxide to 7 parts water, which is within the concentration ratio ranges recited in claims 3-4, 10 and 14. (See, col. 3, 38-40). Moreover, this disclosure meets the limitation of claims 31-34 where the solution has a concentration ratio of 5:1:1 of H_2O : NH_4OH : H_2O_2 .

Szejewski ('499) further discloses that the solution is heated and maintained between about 50°C – about 70°C (See, col.3, 45-49), and the substrate is in the solution for about 5 seconds to about 15 minutes to remove the excess residue. (See, col.3, 50-57). These teachings fall within the time and temperature ranges, which are between about 2 to about 45 minutes and between about room temperature to about 70°C, recited in claims 7-9, 11, 14-20, 26-28, 30, 34, and 41 for applying

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the solution of ammonium hydroxide and peroxide or a solution that is comprised of ammonium hydroxide and peroxide and other components to the substrate.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) with the teachings of Szwejkowski ('499) because polysilicon and carbon are in the same chemical series; therefore, it is obvious the cleaning solution and process disclosed in Szwejkowski ('499), used on a polysilicon layer can be used on a carbon layer to remove photoresist residue, while leaving the underlying layers undamaged.

10. Claims 5-6, 11,15-16, 25-29 and 31-34, are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) and Szwejkowski ('499) as applied to claims 1-4, 7-14, 16-21, 24-35, 37, and 39-41 above, and further in view of Chen ('435).

Liu ('078) and Szwejkowski ('499) are relied upon as discussed in the rejection of claims 1-4, 7-14, 16-21, 24-35, 37, and 39-41 in paragraph 9 above.

Liu ('078) and Szwejkowski ('499) fail to disclose solutions of ammonium hydroxide and peroxide that may include other components with a concentration ratio of about 100:3:2 (claims 11, 15-16, 31-34), or a concentration ratio that ranges from about 100:1:2 to about 100:3:2 (claim 5) or from about 100:1:1 to about 100:3:3 (claim 6), $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$. Dilute solutions of ammonium hydroxide and hydrogen peroxide, which may include other components, and are used as cleaning solutions, are disclosed in Chen ('435).

Chen ('435) discloses a method of cleaning or stripping photoresist from photomasks by using solutions of ammonium hydroxide and hydrogen peroxide. In one embodiment Chen ('435) discloses applying a very dilute solution of ammonium hydroxide and hydrogen peroxide, with concentration ratios of 1:2-10:200-1000 that can be simplified to a ratio of .5:1-5:100-500, at low temperatures to clean or strip photoresist from a photomask. (See, para. 0024). This disclosure

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meets the limitation of claims 5-6, 11, 15-16, 31-34 and 42, where solutions of ammonium hydroxide and hydrogen peroxide that may also contain other components, have a concentration ratio of 100:3:2 (claims 11,15-16, and 31-34), or a concentration ratio that ranges from about 100:1:2 to about 100:3:2 (claim 5) or from about 100:1:1 to about 100:3:3 (claim 6), H_2O : NH_4OH : H_2O_2 .

Liu ('078) and Szejewski ('499) also fail to disclose treatment solutions of ammonium hydroxide and peroxide that may contain other components such as those recited in claims 25-29 and 33-34. Treatment solutions such as these are also taught in Chen ('435).

Chen ('435) discloses various solutions, which can be used to clean or strip resist from a photomask. One solution is comprised of an aqueous dilute solution of ammonium hydroxide and hydrogen peroxide (dAPM). (See, para. 0024 and 0027). One solution is comprised of sulfuric acid and ozone (SOM). (See, para 0020) Both components of this solution are recited in claims 25-29 and 33-34 as components that may be included in the treatment solution. The other solution is comprised of sulfuric acid and hydrogen peroxide (SPM), which includes components that are recited in claims 25-29 and 33-34 as other components of the treatment solution. (See, para. 0034). Chen ('435) further discloses the various solutions can be combined and applied to the structure to strip or remove photoresist. (See, para. 0034 and 0043). This disclosure in Chen ('435) teaches the limitation of claims 25-29 and 33-34 where the treatment solution can be comprised of various combinations of solutions including for example aqueous solutions of ammonium hydroxide and hydrogen peroxide (dAPM) and sulfuric acid and hydrogen peroxide (SPM).

The disclosures in Chen ('435) also meet the limitation of claim 35, where the surface treating solution includes ozone and the limitation of claim 36 where the surface treating solution is comprised of ozone (SOM) and one of the solutions recited in claim 36, which can be, for example,

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a solution of aqueous sulfuric acid and hydrogen peroxide, referred to as SPM in Chen ('435) (See, para. 0020).

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to combine the teachings of Liu ('078) and Szejewski ('499) with the teachings of Chen ('435) because Chen ('435) teaches that dilute solutions of ammonium hydroxide and hydrogen peroxide, that may include other components, can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

11. Claims 21-23, 37-38 and 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) and Szejewski ('499) as applied to claims 1-4, 7-14, 16-21, 24-35, 37, and 39-41 and further in view of Fang ('338).

Liu ('078) and Szejewski ('499) are relied upon as discussed in the rejection of claims 1-4, 7-14, 16-21, 24-35, 37, and 39-41 in paragraph 9 above.

Liu ('078) and Szejewski ('499) fail to disclose treatment solutions of sulfuric acid and citric acid that may include other components, with a concentration ratio of 100:3:2 (claim 22) or 100:2:2 (claim 23) or within a range of about 100:3:2 to about 100:2:2 (claim 42), $\text{H}_2\text{O}:\text{H}_2\text{SO}_4:\text{C}_6\text{H}_8\text{O}_7$. Solutions comprised of sulfuric acid and citric acid that include other components are disclosed in Fang ('338).

Fang ('338) teaches a method to deposit a cobalt containing capping layer. As part of this process there is a pre-clean step where the substrate is exposed to a complexing agent solution to remove oxides or other residues such as organic residues, resist, and other polymeric residues from previous fabrication processes. (See, para.0028). This pre-clean step is analogous to the step recited in claims 21 and 37, where the substrate is treated with a solution to remove residual resist without damaging the underlying layers. The complexing agent is a solution that consists of at least one acid,

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a pH adjusting agent and other additives including citric acid and other acids such as sulfuric acid.

(See, para.0029).

One exemplary complexing agent solution disclosed in Fang ('338) is comprised of water, citric acid in a concentration ratio of .05M to about 1.0M, EDTA, sulfuric acid in a concentration of .05N to about 1.0N and TMAH or ammonium in a concentration to adjust the pH to a range from about 1.5 to 10. (See, para. 0030). This disclosure meets the limitation of claims 21-23 and 42 where the surface treating solution is comprised of sulfuric acid and citric acid and the limitation of claims 37-38 where the surface treating solution is a sulfuric acid containing solution and includes at least aqueous citric acid. Although Fang ('338) does not disclose the concentration ratio recited in claims 22, 23, and 42, one of ordinary skill in the art would be able to determine the appropriate concentration ratio to achieve a solution that would remove residual resist without damaging the underlying layers.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to combine the teachings of Liu ('078) with the teachings of Szejewski ('499) and Fang ('338), because Szejewski ('499) and Fang ('338) teach that one can remove residual resist from structures such as the one disclosed in Liu ('078) with the solutions they disclose to prepare the structure for further processing without damaging the underlying layers of the structure.

Double Patenting

12. A rejection based on double patenting of the "same invention" type finds its support in the language of 35 U.S.C. 101, which states that "whoever invents or discovers any new and useful process ... may obtain a patent therefor ..." (Emphasis added). Thus, the term "same invention," in this context, means an invention drawn to identical subject matter. See *Miller v. Eagle Mfg. Co.*, 151 U.S. 186 (1894); *In re Ockert*, 245 F.2d 467, 114 USPQ 330 (CCPA 1957); and *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970).

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This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

14. Applicant's arguments filed 03/09/2007 have been fully considered but they are not persuasive.

Applicant argues that in the reference Liu ('078) there is no suggestion of a problem with residual resist material remaining after the removal of photoresist, and that in the Szwejkowski ('499) reference there is no suggestion that the silicon oxide film removed is photoresist. Therefore, Applicant argues that the combination of references fails to describe, or suggest the claimed features of removing the resist; and surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and to the substrate.

In the rejection of claims 1-4, 7-14, 16-21, 24-35, 37 and 38-41 Examiner did not rely on Liu ('078) as teaching the limitation that residual resist remained after the photoresist material was stripped. The limitation of removing residual resist was taught in Szwejkowski ('499). Although, Szwejkowski ('499) does not explicitly state the polymeric silicon oxide-containing residue on the polysilicon layer is resist, it is inherent the residue includes resist material, which remains from the process where the resist layer is used as an etch mask for the underlying polysilicon layer. The residue, which contains resist material, is then removed when the structure is exposed to the hydroxide/peroxide solution. Moreover, Applicant has assumed the etching step using the resist layer as a mask removes all the resist material that is used to pattern the underlying polysilicon layer. Therefore, Liu ('078) in view of Szwejkowski ('499) does disclose, teach or suggest all the limitations of claims 1-4, 7-14, 16-21, 24-35, 37 and 39-41.

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Applicant further argues that while Chen ('435) is used to demonstrate that solutions of ammonium hydroxide and peroxide are known, it does not cure the failure of the other references to suggest a surface treatment to remove residual resist material. However, as stated in the above response to Applicant's initial argument, Liu ('078) in view of Szejewski ('499) does teach removing resist and surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and the substrate. Therefore, Liu ('078) in view of Szejewski ('499) and further in view of Chen ('435) does disclose, teach or suggest all the limitations of claims 5-6, 11, 15-16, 25-29 and 31-34.

Applicant then argues that while Fang ('338) is used to demonstrate that solutions including sulfuric acid and citric acid are known, it does not cure the failure of Liu ('078) and Szejewski ('499) to suggest a surface treatment to remove residual resist material. However, Liu ('078) does teach a resist layer disposed over at least one ARC, and Liu ('078) in view of Szejewski ('499) teaches a step of surface treating the substrate to remove residual resist. Therefore, Liu ('078) in view of Szejewski ('499) and further in view of Fang ('338) does disclose, teach or suggest all the limitations of claims 21-23, 37-38 and 42.

15. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be

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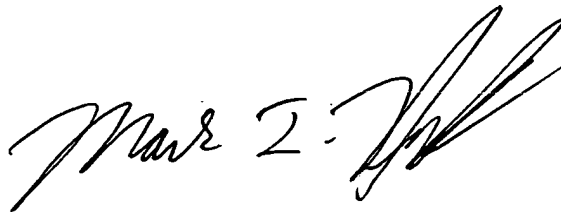
calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Caleen O. Sullivan whose telephone number is 571-272-6569. The examiner can normally be reached Monday-Friday, 8:30am-5:00pm. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

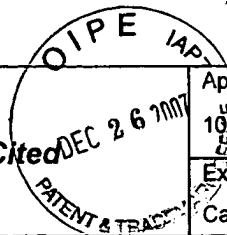
Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

COS, 04/17/2007



MARK E. HUFF
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700

Notice of References Cited



Application/Control No.

10/788,889

Applicant(s)/Patent Under
Reexamination
SHEA ET AL.

Examiner

Caleen O. Sullivan

Art Unit

1756

Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,064,078	06-2006	Liu et al.	438/717
*	B	US-5,147,499	09-1992	Szwejkowski et al.	438/704
*	C	US-2005/0026435	02-2005	Chen et al.	438/689
*	D	US-2005/0161338	07-2005	Fang et al.	205/176
*	E	US-2006/0263729	11-2006	Shea et al.	430/311
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

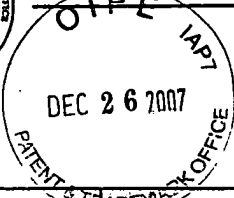
NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/788,889

02/27/2004

Kevin Shea

303.867US1

4555

21186 7590 08/17/2007
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EXAMINER

SULLIVAN, CALEEN O

ART UNIT

PAPER NUMBER

1756

MAIL DATE

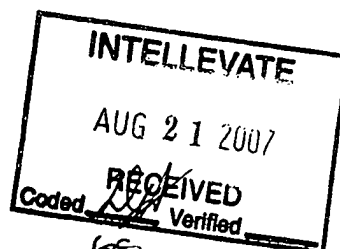
DELIVERY MODE

08/17/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

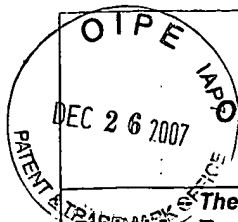
The time period for reply, if any, is set in the attached communication.



Schwegman Lundberg
Woessner & Kluth P.A.

AUG 21 2007

RECEIVED



Office Action Summary

Application No.

10/788,889

Applicant(s)

SHEA ET AL.

Examiner

Caleen O. Sullivan

Art Unit

1756

The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 August 2007.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-11, 24-34 and 39-42 is/are pending in the application.
- 4a) Of the above claim(s) 12-23, 35-38 and 43-50 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-11, 24-34 and 39-42 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 09 March 2007 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>08/02/07</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114.

Applicant's submission filed on 06/28/2007 has been entered.

2. Claims 1-11, 24-34 and 39-42 are presented.
3. Claims 12-23, 35-38 and 43-50 are cancelled.

Response to Amendment

4. Applicant has amended claims 3-6, 10-11 and 31-34 in response to the rejection of these claims under 35 USC 112 2nd paragraph. The amendment to the claims has overcome the rejection under 35 USC 112 2nd paragraph for indefiniteness as well as the rejection under 35 USC 112 1st paragraph, for failure to define the concentration ratios; therefore, Examiner has withdrawn those rejections.

5. Applicant's amendments to claims 1 and 39 has not overcome the rejection previously presented because Liu ('078) in view of Szejewski ('499) does contemplate the limitations added by Applicant's amendments of claims 1 and 39. Therefore, Examiner maintains the rejections presented in the previous Office Action.

6. Applicant has cancelled claims 12-23 and 35-38 which were previously rejected under 35 USC 101 double patenting over claims 1-12 and 24-27 of copending application 11/494,056; therefore, Examiner withdraws this rejection. However, until a terminal disclaimer is offered the rejection of

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claims 1-11, 24-34 and 39-42 under non-statutory obviousness-type double patenting cannot be withdrawn. Therefore, Examiner restates those grounds of rejection.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

8. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

9. Claims 1-4, 7-11, 24-34 and 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499).

Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch and then the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). This disclosure teaches the limitations of claim 1-2, 7, 9-11, 24, 29, and 39-41, where a carbon containing hard mask over a substrate with a resist is patterned,

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where the resist is removed, where patterning the hard mask includes patterning amorphous carbon, and where the substrate is then patterned by a dry etch method through the hard mask.

Liu ('078) also teaches the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56- col. 6, 45; Fig.3A-3F).

However, Liu ('078) fails to teach a process step where the surface of the substrate is treated with a solution to remove residual resist disposed in contact with the substrate under conditions that are not damaging to the underlying layers. Szwejkowski ('499) discloses a method, which teaches such process steps.

Szwejkowski ('499) discloses a method to remove sidewall residues remaining after a polysilicon layer that has been masked with a photoresist layer is etched. The residues from the etch process are removed without undercutting the remaining polysilicon, using a solution of ammonium hydroxide and peroxide. (See, col.2, 26-39 and 57-col.3, 2). This disclosure teaches the limitation of claims 1-11, 24-29, 31-34 and 40-41 where the substrate is treated with a solution of ammonium hydroxide and peroxide to remove residual resist disposed in contact with the substrate under conditions that are not damaging to the underlying layers.

Szwejkowski ('499) also teaches the solution of aqueous hydrogen peroxide and ammonium hydroxide has a concentration ratio by volume of about 1 part hydroxide to 2 parts peroxide to 7 parts water, which is within the concentration ratio ranges recited in claims 3-4 and 10. (See, col. 3, 38-40). Moreover, this disclosure meets the limitation of claims 31-34 where the solution has a volume concentration ratio of 5:1:1 of H_2O : NH_4OH : H_2O_2 .

Szwejkowski ('499) further discloses that the solution is heated and maintained between about 50°C – about 70°C (See, col.3, 45-49), and the substrate is in the solution for about 5 seconds

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to about 15 minutes to remove the excess residue. (See, col.3, 50-57). These teachings fall within the time and temperature ranges, which are between about 2 to about 45 minutes and between about room temperature to about 70°C, recited in claims 7-9, 11, 26-28, 30, 34, and 41 for applying the solution of ammonium hydroxide and peroxide or a solution that is comprised of ammonium hydroxide and peroxide and other components to the substrate.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) in view of the teachings of Szwejkowski ('499) because polysilicon and carbon are in the same chemical series; therefore, it is obvious the cleaning solution and process disclosed in Szwejkowski ('499), used on a polysilicon layer can be used on a carbon layer to remove photoresist residue, while leaving the underlying layers undamaged.

10. Claims 5-6, 11, 25-29 and 31-34, are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) as applied to claims 1-4, 7-11, 24-34 and 39-41 in paragraph 9 above, and further in view of Chen ('435).

Liu ('078) and Szwejkowski ('499) fail to disclose solutions of ammonium hydroxide and peroxide that may include other components with a volume concentration ratio of about 100:3:2 (claims 11, 15-16, 31-34), or a volume concentration ratio that ranges from about 100:1:2 to about 100:3:2 (claim 5) or from about 100:1:1 to about 100:3:3 (claim 6), H₂O: NH₄OH: H₂O₂. Dilute solutions of ammonium hydroxide and hydrogen peroxide, which may include other components, and are used as cleaning solutions, are disclosed in Chen ('435).

Chen ('435) discloses a method of cleaning or stripping photoresist from photomasks by using solutions of ammonium hydroxide and hydrogen peroxide. In one embodiment Chen ('435) discloses applying a very dilute solution of ammonium hydroxide and hydrogen peroxide, with volume concentration ratios of 1:2-10:200-1000 that can be simplified to a ratio of .5:1-5:100-500, at

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low temperatures to clean or strip photoresist from a photomask. (See, para. 0024). This disclosure meets the limitation of claims 5-6, 11, 31-34 and 42, where solutions of ammonium hydroxide and hydrogen peroxide that may also contain other components, have a volume concentration ratio of 100:3:2 (claims 11 and 31-34), or a volume concentration ratio that ranges from about 100:1:2 to about 100:3:2 (claim 5) or from about 100:1:1 to about 100:3:3 (claim 6), H_2O : NH_4OH : H_2O_2 .

Liu ('078) and Szwejkowski ('499) also fail to disclose treatment solutions of ammonium hydroxide and peroxide that may contain other components such as those recited in claims 25-29 and 33-34. Treatment solutions such as these are also taught in Chen ('435).

Chen ('435) discloses various solutions, which can be used to clean or strip resist from a photomask. One solution is comprised of an aqueous dilute solution of ammonium hydroxide and hydrogen peroxide (dAPM). (See, para. 0024 and 0027). One solution is comprised of sulfuric acid and ozone (SOM). (See, para 0020) Both components of this solution are recited in claims 25-29 and 33-34 as components that may be included in the treatment solution. The other solution is comprised of sulfuric acid and hydrogen peroxide (SPM), which includes components that are recited in claims 25-29 and 33-34 as other components of the treatment solution. (See, para. 0034). Chen ('435) further discloses the various solutions can be combined and applied to the structure to strip or remove photoresist. (See, para. 0034 and 0043). This disclosure in Chen ('435) teaches the limitation of claims 25-29 and 33-34 where the treatment solution can be comprised of various combinations of solutions including for example aqueous solutions of ammonium hydroxide and hydrogen peroxide (dAPM) and sulfuric acid and hydrogen peroxide (SPM).

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szwejkowski ('499) in view of the teachings of Chen ('435) because Chen ('435) teaches that dilute solutions of ammonium hydroxide and

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hydrogen peroxide, that may include other components, can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

11. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szejewski ('499) as applied to claims 1-4, 7-11, 24-34 and 39-41 in paragraph 9 above and further in view of Fang ('338).

Liu ('078) and Szejewski ('499) fail to disclose treatment solutions of sulfuric acid and citric acid that may include other components, with a volume concentration ratio range of about 100:3:2 to about 100:2:2 (claim 42), $\text{H}_2\text{O} : \text{H}_2\text{SO}_4 : \text{C}_6\text{H}_8\text{O}_7$. Solutions comprised of sulfuric acid and citric acid that include other components are disclosed in Fang ('338).

Fang ('338) teaches a method to deposit a cobalt containing capping layer. As part of this process there is a pre-clean step where the substrate is exposed to a complexing agent solution to remove oxides or other residues such as organic residues, resist, and other polymeric residues from previous fabrication processes. (See, para.0028). This pre-clean step is analogous to the step where the substrate is treated with a solution to remove residual resist without damaging the underlying layers. The complexing agent is a solution that consists of at least one acid, a pH adjusting agent and other additives including citric acid and other acids such as sulfuric acid. (See, para.0029).

One exemplary complexing agent solution disclosed in Fang ('338) is comprised of water, citric acid in a concentration ratio of .05M to about 1.0M, EDTA, sulfuric acid in a concentration of .05N to about 1.0N and TMAH or ammonium in a concentration to adjust the pH to a range from about 1.5 to 10. (See, para. 0030). This disclosure meets the limitation of claim 42 where the surface treating solution is comprised of sulfuric acid and citric acid. Although Fang ('338) does not disclose the volume concentration ratio recited in claim 42, one of ordinary skill in the art would be able to

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determine the appropriate volume concentration ratio to achieve a solution that would remove residual resist without damaging the underlying layers.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szwejkowski ('499) in view of the teachings of Fang ('338), because Fang ('338) teaches that one can remove residual resist from structures such as the one disclosed in Liu ('078) with the solutions disclosed to prepare the structure for further processing without damaging the underlying layers of the structure.

Double Patenting

12. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-11, 24-34 and 39-42 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 13-16, 19-20 and 23-24 of copending Application No. 11/494,056 (US-2006/0263729). Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims of copending

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Application No. 11/494,056 (US-2006/0263729) are broader recitations of the claims of Application No. 10/788,889.

This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

13. Applicant's arguments filed 03/09/2007 have been fully considered but they are not persuasive.

14. Applicant argues that in the reference Liu ('078) there is no suggestion of a problem with residual resist material remaining after the removal of photoresist, and that in the Szwejkowski ('499) reference there is no suggestion that the silicon oxide film removed is photoresist. Therefore, Applicant argues that the combination of references fails to describe, or suggest the claimed features of removing the resist; and surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and to the substrate.

However, Examiner did not rely on Liu ('078) as teaching the limitation that residual resist remained after the photoresist material was stripped. The limitation of removing residual resist was taught in Szwejkowski ('499). Although, Szwejkowski ('499) does not explicitly state the polymeric silicon oxide-containing residue on the polysilicon layer is resist, it is inherent the residue includes resist material, which remains from the process where the resist layer is used as an etch mask for the underlying polysilicon layer. The residue, which contains resist material, is then removed when the structure is exposed to the hydroxide/peroxide solution. Moreover, Applicant assumes that the etching step using the resist layer as a mask removes all the resist material when used to pattern the underlying polysilicon layer. Therefore, Examiner maintains that Liu ('078) in view of Szwejkowski ('499) does disclose, teach or suggest all the limitations of claims 1-4, 7-11, 24-34 and 39-41.

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Applicant further argues that while Chen ('435) is used to demonstrate that solutions of ammonium hydroxide and peroxide are known, it does not cure the failure of the other references to suggest a surface treatment to remove residual resist material. However, as stated in the above response to Applicant's initial argument, Liu ('078) in view of Szwejkowski ('499) does teach removing resist and surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and the substrate. Therefore, Liu ('078) in view of Szwejkowski ('499) and further in view of Chen ('435) does disclose, teach and/or suggest all the limitations of claims 5-6, 11, 25-29 and 31-34.

Applicant then argues that while Fang ('338) is used to demonstrate that solutions including sulfuric acid and citric acid are known, it does not cure the failure of Liu ('078) and Szwejkowski ('499) to suggest a surface treatment to remove residual resist material. However, Liu ('078) does teach a resist layer disposed over at least one ARC, and Liu ('078) in view of Szwejkowski ('499) teaches a step of surface treating the substrate to remove residual resist. Therefore, the combination of Liu ('078) and Szwejkowski ('499) modified in view of the teachings of Fang ('338) does disclose, teach and/or suggest all the limitations of claim 42.

Applicant amended claims 1 and 39 to include the limitation that the residual resist removed is disposed in contact with the substrate; however, Examiner is of the position that the combination of Liu ('078) and Szwejkowski ('499) contemplates the limitation added by Applicant's amendment of claims 1 and 39. Applicant further amended claim 39 to include the limitation that the photoresist layer over the hard mask layer is removed; however, Examiner is of the position that the combination of Liu ('078) and Szwejkowski ('499) teaches this limitation as well.

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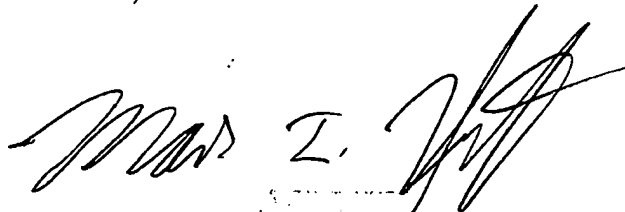
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Cateen O. Sullivan whose telephone number is 571-272-6569. The examiner can normally be reached Monday-Friday, 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/COS/, 08/08/07.



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EXAMINER

SULLIVAN, CALEEN O

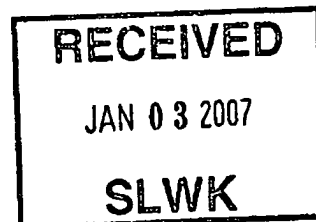
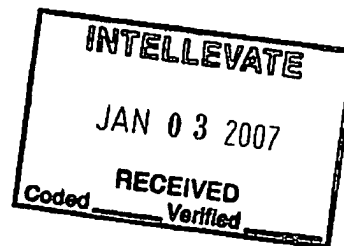
ART UNIT PAPER NUMBER

1756

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	12/29/2006	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.



Office Action Summary	Application No. 10/788,889	Applicant(s) SHEA ET AL.	
	Examiner Caleen O. Sullivan	Art Unit 1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-50 is/are pending in the application.
- 4a) Of the above claim(s) 43-50 is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-42 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 February 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>02/27/04 and 09/06/05</u> | 6) <input type="checkbox"/> Other: ____ |

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-42, drawn to a process of treating a dry-developed hard mask, classified in class 430, subclass 322.
 - II. Claims 43-50, drawn to compositions for surface treatment of a dry-developed hard mask, classified in class 252, subclass 79.1.

The inventions are distinct, each from the other because of the following reasons:

2. Inventions I and II are related as product and process of use. The inventions can be shown to be distinct if either or both of the following can be shown: (1) the process for using the product as claimed can be practiced with another materially different product or (2) the product as claimed can be used in a materially different process of using that product. See MPEP § 806.05(h). In the instant case the product as claimed can be used in a materially different process such as developing a photoresist layer.

3. Because these inventions are independent or distinct for the reasons given above and there would be a serious burden on the examiner if restriction is not required because the inventions have acquired a separate status in the art due to their recognized divergent subject matter, restriction for examination purposes as indicated is proper.

4. During a telephone conversation with Attorney David Suhl on 11-26-2006 a provisional election was made without traverse to prosecute the invention of Group I, claims 1-42. Affirmation of this election must be made by applicant in replying to this Office action. Claims 43-50 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

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5. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Drawings

6. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because the resist layer in Figure 1A has been misnumbered with reference character "119" instead of reference character "118" as designated in the specification. (See, page 5). Also the resist stack in Figure 1A has been misnumbered with reference character "101" instead of reference character "100" as designated in the specification. (See, page 4). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

7. The use of the trademark Aleg® 820 has been noted in this application. It should be capitalized wherever it appears and be accompanied by the generic terminology. In the specification on pages 3, 9 and 11 the trademark Aleg® 820 is used but is not accompanied by the required generic terminology. Appropriate correction is required.

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Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner, which might adversely affect their validity as trademarks.

Claim Rejections - 35 USC § 112

8. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 3-6, 10-11, 14-15, 16-20, 22-23, 31-34 and 42 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contain subject matter, which was not described in the specification. In the aforementioned claims applicant includes limitations specifying "concentration ratios" for the "surface treating solutions" used in the process of removing residual photoresist; however, applicant has failed to describe in the specification if these "concentration ratios" are volume, weight, or mole ratios. For the purpose of examination, Examiner has considered the "concentration ratios" to be volume ratios in the rejections that follow.

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 3-6, 10-38 and 42 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 3-6, 10-11, 14-20, 22-23, 31-34 and 42 are include the term "concentration ratio;" however, it is unclear as to whether the concentration ratio is a volume, a weight, or a mole ratio.

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For the purpose of examination, Examiner has considered the "concentration ratio" to be a volume ratio in the rejections that follow.

Claims 12, 16, 21, 35 and 37 include the phrase "... resist stack including at least one antireflective coating...selected from a dielectric antireflective coating and a bottom antireflective coating, ..." which Examiner considers to be a claim that includes a Markush group written in improper format. "Alternative expressions are permitted if they present no uncertainty or ambiguity with respect to the question of scope or clarity of the claims. One acceptable form of alternative expression, which is commonly referred to as a Markush group, recites members as being "selected from the group consisting of A, B and C." See *Ex parte Markush*, 1925 C.D. 126 (Comm'r Pat. 1925). These claims should be amended to recite proper Markush Language.

Claims 13, 24-29, 32-34 and 36 contains the trademark/trade name Aleg®820. Where a trademark or trade name is used in a claim as a limitation to identify or describe a particular material or product, the claim does not comply with the requirements of 35 U.S.C. 112, second paragraph. See *Ex parte Simpson*, 218 USPQ 1020 (Bd. App. 1982). The claim scope is uncertain since the trademark or trade name cannot be used properly to identify any particular material or product. A trademark or trade name is used to identify a source of goods, and not the goods themselves. Thus, a trademark or trade name does not identify or describe the goods associated with the trademark or trade name. In the present case, the trademark/trade name is used to identify/describe Aleg®820 solution and, accordingly, the identification/description is indefinite.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

12. Claims 1-4, 7-14, 16-21, 24-35, 37, and 39-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499).

Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch and then the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). This disclosure teaches the limitation of claim 1-2, 7, 9-11, 24, 29, and 39-41, where a carbon containing hard mask over a substrate with a resist is patterned, where patterning the hard mask includes patterning amorphous carbon, and where the substrate is then patterned by a dry etch method through the hard mask.

Liu ('078) also teaches the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56- col. 6, 45; Fig.3A-3F). This

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teaching meets the limitation of claims 12, 16, 21, 35 and 37 where an amorphous carbon hard mask that includes a resist stack is patterned. Moreover, this teaching meets the limitations of the aforementioned claims where the resist stack includes one ARC over the hard mask, which is selected from a dielectric anti-reflective coating (DARC) and a bottom anti-reflective coating (BARC), and a photoresist layer is over the at least one ARC.

However, Liu ('078) fails to teach a process step where the surface of the substrate is treated with a solution to remove residual resist under conditions that are not damaging to the underlying layers. Szwejkowski ('499) discloses a method, which teaches such process steps.

Szwejkowski ('499) discloses a method to remove sidewall residues remaining after a polysilicon layer that has been masked with a photoresist layer is etched. The residues from the etch process are removed without undercutting the remaining polysilicon, using a solution of ammonium hydroxide and peroxide. (See, col.2, 26-39 and 57-col.3,2). This disclosure teaches the limitation of claims 1-12, 14-16, 21, 24-29, 31-35, 37 and 40-41 where the substrate is treated with a solution of ammonium hydroxide and peroxide to remove residual resist under conditions that are not damaging to the underlying layers.

Szwejkowski ('499) also teaches the solution of aqueous hydrogen peroxide and ammonium hydroxide has a concentration ratio by volume of about 1 part hydroxide to 2 parts peroxide to 7 parts water, which is within the concentration ratio ranges recited in claims 3-4, 10 and 14. (See, col. 3, 38-40). Moreover, this disclosure meets the limitation of claims 31-34 where the solution has a concentration ratio of 5:1:1 of H_2O : NH_4OH : H_2O_2 .

Szwejkowski ('499) further discloses that the solution is heated and maintained between about 50°C – about 70°C (See, col.3, 45-49), and the substrate is in the solution for about 5 seconds to about 15 minutes to remove the excess residue. (See, col.3, 50-57). These teachings fall within the

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time and temperature ranges, which are between about 2 to about 45 minutes and between about room temperature to about 70°C, recited in claims 7-9, 11, 14-20, 26-28, 30, 34, and 41 for applying the solution of ammonium hydroxide and peroxide or a solution that is comprised of ammonium hydroxide and peroxide and other components to the substrate.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) with the teachings of Szwajkowski ('499) because polysilicon and carbon are in the same chemical series; therefore, it is obvious the cleaning solution and process disclosed in Szwajkowski ('499), used on a polysilicon layer can be used on a carbon layer to remove photoresist residue, while leaving the underlying layers undamaged.

13. Claims 5-6, 11, 15-16, 25-29 and 31-34, are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) and Szwajkowski ('499) as applied to claims 1-4, 7-14, 16-21, 24-35, 37, and 39-41 above, and further in view of Chen ('435).

Liu ('078) and Szwajkowski ('499) are relied upon as discussed in the rejection of claims 1-4, 7-14, 16-21, 24-35, 37, and 39-41 in paragraph 12 above.

Liu ('078) and Szwajkowski ('499) fail to disclose solutions of ammonium hydroxide and peroxide that may include other components with a concentration ratio of about 100:3:2 (claims 11, 15-16, 31-34), or a concentration ratio that ranges from about 100:1:2 to about 100:3:2 (claim 5) or from about 100:1:1 to about 100:3:3 (claim 6), H_2O : NH_4OH : H_2O_2 . Dilute solutions of ammonium hydroxide and hydrogen peroxide, which may include other components, and are used as cleaning solutions, are disclosed in Chen ('435).

Chen ('435) discloses a method of cleaning or stripping photoresist from photomasks by using solutions of ammonium hydroxide and hydrogen peroxide. In one embodiment Chen ('435) discloses applying a very dilute solution of ammonium hydroxide and hydrogen peroxide, with

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concentration ratios of 1:2-10:200-1000 that can be simplified to a ratio of .5:1-5:100-500, at low temperatures to clean or strip photoresist from a photomask. (See, para. 0024). This disclosure meets the limitation of claims 5-6, 11, 15-16, 31-34 and 42, where solutions of ammonium hydroxide and hydrogen peroxide that may also contain other components, have a concentration ratio of 100:3:2 (claims 11,15-16, and 31-34), or a concentration ratio that ranges from about 100:1:2 to about 100:3:2 (claim 5) or from about 100:1:1 to about 100:3:3 (claim 6), H_2O : NH_4OH : H_2O_2 .

Liu ('078) and Szejewski ('499) also fail to disclose treatment solutions of ammonium hydroxide and peroxide that may contain other components such as those recited in claims 25-29 and 33-34. Treatment solutions such as these are also taught in Chen ('435).

Chen ('435) discloses various solutions, which can be used to clean or strip resist from a photomask. One solution is comprised of an aqueous dilute solution of ammonium hydroxide and hydrogen peroxide (dAPM). (See, para. 0024 and 0027). One solution is comprised of sulfuric acid and ozone (SOM). (See, para 0020) Both components of this solution are recited in claims 25-29 and 33-34 as components that may be included in the treatment solution. The other solution is comprised of sulfuric acid and hydrogen peroxide (SPM), which includes components that are recited in claims 25-29 and 33-34 as other components of the treatment solution. (See, para. 0034). Chen ('435) further discloses the various solutions can be combined and applied to the structure to strip or remove photoresist. (See, para. 0034 and 0043). This disclosure in Chen ('435) teaches the limitation of claims 25-29 and 33-34 where the treatment solution can be comprised of various combinations of solutions including for example aqueous solutions of ammonium hydroxide and hydrogen peroxide (dAPM) and sulfuric acid and hydrogen peroxide (SPM).

The disclosures in Chen ('435) also meet the limitation of claim 35, where the surface treating solution includes ozone and the limitation of claim 36 where the surface treating solution is

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comprised of ozone (SOM) and one of the solutions recited in claim 36, which can be, for example, a solution of aqueous sulfuric acid and hydrogen peroxide, referred to as SPM in Chen ('435) (See, para. 0020).

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to combine the teachings of Liu ('078) and Szwejkowski ('499) with the teachings of Chen ('435) because Chen ('435) teaches that dilute solutions of ammonium hydroxide and hydrogen peroxide, that may include other components, can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

14. Claims 21-23, 37-38 and 42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) and Szwejkowski ('499) as applied to claims 1-4, 7-14, 16-21, 24-35, 37, and 39-41 and further in view of Fang ('338).

Liu ('078) and Szwejkowski ('499) are relied upon as discussed in the rejection of claims 1-4, 7-14, 16-21, 24-35, 37, and 39-41 in paragraph 12 above.

Liu ('078) and Szwejkowski ('499) fail to disclose treatment solutions of sulfuric acid and citric acid that may include other components, with a concentration ratio of 100:3:2 (claim 22) or 100:2:2 (claim 23) or within a range of about 100:3:2 to about 100:2:2 (claim 42), $\text{H}_2\text{O}:\text{H}_2\text{SO}_4:\text{C}_6\text{H}_8\text{O}_7$. Solutions comprised of sulfuric acid and citric acid that include other components are disclosed in Fang ('338).

Fang ('338) teaches a method to deposit a cobalt containing capping layer. As part of this process there is a pre-clean step where the substrate is exposed to a complexing agent solution to remove oxides or other residues such as organic residues, resist, and other polymeric residues from previous fabrication processes. (See, para.0028). This pre-clean step is analogous to the step recited in claims 21 and 37, where the substrate is treated with a solution to remove residual resist without

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damaging the underlying layers. The complexing agent is a solution that consists of at least one acid, a pH adjusting agent and other additives including citric acid and other acids such as sulfuric acid. (See, para.0029).

One exemplary complexing agent solution disclosed in Fang ('338) is comprised of water, citric acid in a concentration ratio of .05M to about 1.0M, EDTA, sulfuric acid in a concentration of .05N to about 1.0N and TMAH or ammonium in a concentration to adjust the pH to a range from about 1.5 to 10. (See, para. 0030). This disclosure meets the limitation of claims 21-23 and 42 where the surface treating solution is comprised of sulfuric acid and citric acid and the limitation of claims 37-38 where the surface treating solution is a sulfuric acid containing solution and includes at least aqueous citric acid. Although Fang ('338) does not disclose the concentration ratio recited in claims 22, 23, and 42, one of ordinary skill in the art would be able to determine the appropriate concentration ratio to achieve a solution that would remove residual resist without damaging the underlying layers.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to combine the teachings of Liu ('078) with the teachings of Szwejkowski ('499) and Fang ('338), because Szwejkowski ('499) and Fang ('338) teach that one can remove residual resist from structures such as the one disclosed in Liu ('078) with the solutions they disclose to prepare the structure for further processing without damaging the underlying layers of the structure.

Double Patenting

15. A rejection based on double patenting of the "same invention" type finds its support in the language of 35 U.S.C. 101, which states that "whoever invents or discovers any new and useful process ... may obtain a patent therefor ..." (Emphasis added). Thus, the term "same invention," in this context, means an invention drawn to identical subject matter. See *Miller v. Eagle Mfg. Co.*, 151 U.S. 186 (1894); *In re Ockert*, 245 F.2d 467, 114 USPQ 330 (CCPA 1957); and *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970).

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A statutory type (35 U.S.C. 101) double patenting rejection can be overcome by canceling or amending the conflicting claims so they are no longer coextensive in scope. The filing of a terminal disclaimer cannot overcome a double patenting rejection based upon 35 U.S.C. 101.

Claims 12-23 and 35-38 are provisionally rejected under 35 U.S.C. 101 as claiming the same invention as that of claims 1-12 and 24-27 of copending Application No. 11/494,056 (US-2006/0263729). This is a provisional double patenting rejection since the conflicting claims have not in fact been patented.

16. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-11, 24-34 and 39-42 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 13-16, 19-20 and 23-24 of copending Application No. 11/494,056 (US-2006/0263729). Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims of copending Application No. 11/494,056 (US-2006/0263729) are broader recitations of the claims of Application No. 10/788,889.

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This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Calleen O. Sullivan whose telephone number is 571-272-6569. The examiner can normally be reached Monday-Friday, 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

COS
12-18-06


KATHLEEN DUDA
PRIMARY EXAMINER
GROUP 1100

**Notice of References Cited**

Application/Control No. 10/788,889	Applicant(s)/Patent Under Reexamination SHEA ET AL.	
Examiner Caleen O. Sullivan	Art Unit 1756	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,064,078	06-2006	Liu et al.	438/717
*	B	US-5,147,499	09-1992	Szwejkowski et al.	438/704
*	C	US-2005/0026435	02-2005	Chen et al.	438/689
*	D	US-2005/0161338	07-2005	Fang et al.	205/176
*	E	US-2006/0263729	11-2006	Shea et al.	430/311
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

S/N 10/788,889

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Kevin Shea et al.

Examiner: Caleen O Sullivan

Serial No.: 10/788,889

Group Art Unit: 1756

Filed: February 27, 2004

Docket No.: 303.867US1

Title: SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND
SURFACE TREATMENT COMPOSITIONS USED THEREFOR

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.111

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

This paper responds to the Office Action mailed on December 29, 2006. Please amend the above-identified patent application as follows.

IN THE DRAWINGS

Corrected drawings are supplied herewith.

Enclosed is a Replacement Sheet showing the following amendment to Figure 1A.

The incorrect reference numbers 101 and 119 are replaced with the correct reference numbers 100 and 118.

IN THE SPECIFICATION

Please amend the specification as follows:

The paragraph beginning at page 1, line 10 is amended as follows:

The importance of minimizing contamination during semiconductor fabrication processes has been recognized since the early days of the industry. Miniaturization is the process of crowding more semiconductive devices onto a smaller substrate area in order to achieve better device speed, lower energy usage, and better device portability, among others. New processing methods must often be developed to enable miniaturization to be realized. As semiconductor devices have become smaller and more complex, cleanliness requirements have become increasingly stringent, especially for devices with submicron critical dimensions, because the ability to reliably create multi-level metallization structures is increasingly vital. The importance of cleaning and conditioning submicron devices during the fabrication process is also emphasized because small-scale residues that may not have seriously affected the performance of these devices previously, may now cause unacceptable yield loss.

The paragraph beginning at page 1, line 22 is amended as follows:

Dry development processes are used in preparing patterned hard masks. The removal of photoresist material (hereinafter "resist") is challenging since the hard mask material is often amorphous carbon, and the resist is often a carbon-rich composition. During the dry development process, some dry-developed resist can become pooled-up on surfaces that need to be clear for subsequent processing. The pooled-up resist presents a challenge for the fabricator because it represents an unacceptably dirty wafer for further processing. A further challenge is to remove resist from the edges of a wafer, as the resist is often thicker (known as an "edge bead") near the edges due to its mode of being applied to the wafer. Consequently, as residues from the resist tend to ~~pooled-up~~ pool in some areas and as edge-bead resist tends to be present at the edge of the wafer, the total removal of photoresist material may become difficult.

Unremoved resist can be mobilized during subsequent processing that creates further undesirable results during the etch process that uses the hard mask.

The paragraph beginning at page 3, line 7 is amended as follows:

In an embodiment, a second surface treating composition is added to the aqueous ammonium hydroxide and hydrogen peroxide solution. In an embodiment, the second surface treating composition includes aqueous sulfuric acid and citric acid solution. In an embodiment, the second surface treating composition includes aqueous sulfuric acid and hydrogen peroxide solution. In an embodiment, the second surface treating composition includes Aleg® 820 solution, a trademark of, and manufactured by Mallinckrodt Baker, Inc. of St. Louis, Missouri. In an embodiment, the second surface treating composition includes ozone with dilute ammonium hydroxide. In an embodiment, the second surface treating composition includes, and ozone with dilute hydrogen fluoride; often referred to as "fluorozone".

The paragraph beginning at page 9, line 4 is amended as follows:

In an embodiment, a second surface treating composition is added to the aqueous ammonium hydroxide and hydrogen peroxide solution. In an embodiment, the second surface treating composition includes aqueous sulfuric acid and citric acid solution. In an embodiment, the second surface treating composition includes aqueous sulfuric acid and hydrogen peroxide solution. In an embodiment, the second surface treating composition includes Aleg® 820 solution, a trademark of, and manufactured by Mallinckrodt Baker, Inc. of St. Louis, Missouri. In an embodiment, the second surface treating composition includes ozone with dilute ammonium hydroxide in a ratio of about 1000:1:100 H₂O:O₃:NH₄OH to about 1000:2:100.

The paragraph beginning at page 11, line 4 is amended as follows:

In another example, a plurality proportion of aqueous ammonium hydroxide and hydrogen peroxide solution is provided in an H₂O:NH₄OH:H₂O₂ concentration ratio of about 100:3:2. A first minority proportion of aqueous ammonium hydroxide and hydrogen peroxide solution is provided in an H₂O:NH₄OH:H₂O₂ concentration ratio of about 5:1:1. A second minority proportion of at least one solution selected from aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, Aleg® 820 solution, a trademark of, and manufactured by Mallinckrodt Baker, Inc. of St. Louis, Missouri, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride. An amorphous carbon hard

mask is dry developed over a semiconductive substrate. A surface treating process is undertaken with the given solution mixture.

IN THE CLAIMS

Please amend the claims as follows:

1. (Currently Amended) A process comprising:
patterning a carbon-containing hard mask over a substrate with a resist;
removing the resist; and
surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and to the substrate.
2. (Original) The process of claim 1, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution.
3. (Original) The process of claim 1, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio from about 100:3:2 to about 5:1:2.
4. (Original) The process of claim 1, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio from about 5:1:1 to about 5:1:2.
5. (Original) The process of claim 1, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio from about 100:1:2 to about 100:3:2.

6. (Original) The process of claim 1, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio from about 100:1:1 to about 100:3:3.
7. (Original) A process comprising:
patterning a carbon-containing hard mask over a substrate with a resist; and
surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and to the substrate, wherein surface treating includes an aqueous ammonium hydroxide and hydrogen peroxide solution that is applied in a time range from about 2 minutes to about 45 minutes.
8. (Original) The process of claim 7, wherein surface treating includes surface treating with an aqueous ammonium hydroxide and hydrogen peroxide solution that is applied in a temperature range from about room temperature to about 70° C.
9. (Original) The process of claim 7, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, wherein surface treating includes surface treating with an aqueous ammonium hydroxide and hydrogen peroxide solution that is applied in a temperature range from about room temperature to about 70° C.
10. (Original) The process of claim 7, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, wherein surface treating includes:
surface treating with an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio from about 5:1:1 to about 100:3:2; and
a temperature range from about room temperature to about 70° C.

-
11. (Original) The process of claim 7, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, wherein surface treating includes:
- surface treating with an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 100:3:2;
 - a time of about 10 minutes; and
 - a temperature of about 55° C.
12. (Currently Amended) A process comprising:
- patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:
 - at least one antireflective coating disposed over the hard mask, selected from the group consisting of a dielectric antireflective coating and a bottom antireflective coating;
 - and
 - a photoresist layer disposed over the at least one antireflective coating; and
 - surface treating the substrate to remove residual photoresist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate.
13. (Currently Amended) The process of claim 12, wherein surface treating includes rinsing the photoresist with a solution selected from aqueous ammonium hydroxide and hydrogen peroxide solution, aqueous sulfuric acid and citric acid solution, aqueous sulfuric acid and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with dilute ammonium hydroxide, ozone with dilute hydrogen fluoride, and combinations thereof.
14. (Original) The process of claim 12, wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio from about 5:1:1 to about 100:3:2, a time range from about 2 minutes to about 45 minutes, and a temperature range from about room temperature to about 70° C.

15. (Original) The process of claim 12, wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 100:3:2, a time range from about 10 minutes to about 20 minutes, and a temperature range from about 30° C to about 60° C.
16. (Currently Amended) A process comprising:
patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:
at least one antireflective coating disposed over the hard mask, selected from the group consisting of a dielectric antireflective coating and a bottom antireflective coating;
and
a photoresist layer disposed over the at least one antireflective coating; and
surface treating the substrate to remove residual photoresist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 100:3:2, and a temperature of about 55° C.
17. (Original) The process of claim 16, wherein surface treating includes a surface treating time of about 5 minutes.
18. (Original) The process of claim 16, wherein surface treating includes a surface treating time of greater than about 5 minutes to about 10 minutes.
19. (Original) The process of claim 16, wherein surface treating includes a surface treating time of greater than about 10 minutes to about 20 minutes.
20. (Original) The process of claim 16, wherein surface treating includes a surface treating time of greater than about 20 minutes to about 30 minutes.

21. (Currently Amended) A process comprising:

patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:

at least one antireflective coating disposed over the hard mask, selected from the group consisting of a dielectric antireflective coating and a bottom antireflective coating; and

a photoresist layer disposed over the at least one antireflective coating; and surface treating the substrate to remove residual photoresist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, wherein surface treating includes using an aqueous sulfuric acid and citric acid solution for a time of about 10 minutes, and a temperature of about 55° C.

22. (Original) The process of claim 21, wherein surface treating includes using an aqueous sulfuric acid and citric acid solution in an H₂O:H₂SO₄:C₆H₄O₇ concentration ratio of about 100:3:2.

23. (Original) The process of claim 21, wherein surface treating includes using an aqueous sulfuric acid and citric acid solution in an H₂O:H₂SO₄:C₆H₄O₇ concentration ratio of about 100:2:2.

24. (Currently Amended) A process comprising:

patterning a carbon-containing hard mask with a resist over a substrate; and

surface treating the substrate to remove residual resist under conditions that are selective to leaving the carbon-containing hard mask, wherein surface treating includes surface treating with a rinse solution selected from aqueous ammonium hydroxide and hydrogen peroxide solution, aqueous sulfuric acid and citric acid solution, aqueous sulfuric acid and hydrogen peroxide solution, ~~Aleg-820 solution~~, ozone with dilute ammonium hydroxide, ozone with dilute hydrogen fluoride, and combinations thereof.

25. (Currently Amended) The process of claim 24, wherein surface treating includes surface treating with a rinse solution:

in a majority proportion aqueous ammonium hydroxide and hydrogen peroxide solution;
and

in a minority proportion at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride.

26. (Currently Amended) The process of claim 24, wherein surface treating includes surface treating with a rinse solution:

in a majority proportion aqueous ammonium hydroxide and hydrogen peroxide solution;

in a minority proportion at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride; and the process further including:

surface treating for a time range from about 2 minutes to about 45 minutes.

27. (Currently Amended) The process of claim 24, wherein surface treating includes surface treating with a rinse solution:

in a majority proportion aqueous ammonium hydroxide and hydrogen peroxide solution;

in a minority proportion at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride; and the process further including:

surface treating for a temperature range from about room temperature to about 70°

C.

28. (Currently Amended) The process of claim 24, wherein surface treating includes surface treating with a rinse solution:

in a majority proportion aqueous ammonium hydroxide and hydrogen peroxide solution;
in a minority proportion at least one of aqueous sulfuric acid and citric acid solution,
aqueous sulfuric and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with dilute
ammonium hydroxide, and ozone with dilute hydrogen fluoride; and the process further
including:

surface treating for a time range from about 2 minutes to about 45 minutes, and
for a temperature range from about room temperature to about 70° C.

29. (Currently Amended) A process comprising:

patterning a carbon-containing hard mask with a resist over a substrate; and
surface treating the substrate to remove residual resist under conditions that are selective to
leaving the carbon-containing hard mask, wherein surface treating includes:

in a plurality proportion aqueous ammonium hydroxide and hydrogen peroxide
solution; and

in a minority proportion at least two of aqueous sulfuric acid and citric acid
solution, aqueous sulfuric and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with
dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride.

30. (Original) The process of claim 29, wherein surface treating includes surface treating for
a time range from about 2 minutes to about 45 minutes, and a temperature range from about
room temperature to about 70° C.

31. (Original) The process of claim 29, wherein surface treating includes surface treating
with a rinse solution:

the plurality proportion of aqueous ammonium hydroxide and hydrogen peroxide solution
in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 100:3:2; and

the minority proportion including aqueous ammonium hydroxide and hydrogen peroxide
solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 5:1:1.

32. (Currently Amended) The process of claim 29, wherein surface treating includes surface treating with a rinse solution:

the plurality proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 100:3:2;

a first minority proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 5:1:1; and

a second minority proportion of at least one solution selected from aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride.

33. (Currently Amended) The process of claim 29, wherein surface treating includes the rinse solution:

a plurality proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 100:3:2;

a first minority proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 5:1:1;

a second minority proportion of at least one solution selected from aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride; and

wherein the second minority proportion is less than the first minority proportion.

34. (Currently Amended) The process of claim 29, wherein surface treating includes the rinse solution:

a plurality proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 100:3:2;

a first minority proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 5:1:1;

a second minority proportion of at least one solution selected from aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride; and

wherein the second minority proportion is less than the first minority proportion; and the process further including:

surface treating a time range from about 2 minutes to about 45 minutes; and
a temperature range from about room temperature to about 70° C.

35. (Currently Amended) A process comprising:

patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:

at least one antireflective coating disposed over the hard mask, selected from the group consisting of a dielectric antireflective coating and a bottom antireflective coating;
and

a photoresist layer disposed over the at least one antireflective coating; and
surface treating the substrate to remove residual resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, wherein surface treating includes an ozone-containing solution.

36. (Currently Amended) The process of claim 35, wherein surface treating includes the ozone-containing solution and further including at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride.

37. (Currently Amended) A process comprising:

patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:

at least one antireflective coating disposed over the hard mask, selected from the group consisting of a dielectric antireflective coating and a bottom antireflective coating;
and

a photoresist layer disposed over the at least one antireflective coating; and

surface treating the substrate to remove residual resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, wherein surface treating includes a sulfuric acid-containing solution.

38. (Original) The process of claim 37, wherein surface treating includes surface treating with the sulfuric acid-containing solution and further including at least one of aqueous citric acid, aqueous oxaloacetic acid, aqueous acetic acid, and an acetic functional group aqueous acid.

39. (Original) A process comprising:
patterning a carbon-containing hard mask over a substrate with a photoresist;
surface treating the substrate to remove residual photoresist under conditions that are selective to the hard mask and to the substrate; and
dry etching the substrate through the hard mask.

40. (Original) The process of claim 39, wherein the carbon-containing hard mask includes amorphous carbon, and wherein surface treating includes surface treating using an aqueous ammonium hydroxide and hydrogen peroxide solution.

41. (Original) The process of claim 39, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes surface treating using an aqueous ammonium hydroxide and hydrogen peroxide solution, wherein surface treating includes surface treating for a time range from about 2 minutes to about 45 minutes, and wherein surface treating also includes surface treating at a temperature range from about room temperature to about 70° C.

42. (Original) The process of claim 39, wherein surface treating includes surface treating using an aqueous sulfuric acid and citric acid solution in an H₂O:H₂SO₄:C₆H₄O₇ concentration ratio of about 100:3:2 to about 100:2:2, a time of about 10 minutes, and a temperature of about 55° C.

43. – 50. (Canceled)

REMARKS

This paper responds to the Office Action mailed on December 29, 2006.

Claims 1, 12-13, 16, 21, 24-29, and 32-37 are amended, claims 43-50 are canceled without prejudice or waiver of patentable content, and no claims are added; as a result, claims 1-42 are now pending in this application.

Applicant notifies the Examiner of the publication of a related application 2006/0289389A1 on December 28, 2006, and the publication of another member of the same patent family 2006/0263730A1 on November 23, 2006.

Affirmation of Election

Restriction to one of the following claims was required:

- I. Claims 1-41, drawn to a process of treating a dry-developed hard mask, classified in class 430, subclass 322.
- II. Claims 43-50, drawn to compositions for surface treatment of a dry-developed hard mask, classified in class 252, subclass 79.1

As provisionally elected by Applicant's representative, **David Suhl**, on November 26, 2006, Applicant elects to prosecute the invention of Group I, claims 1-42, without traverse.

The claims of the non-elected invention, claims 43-50, are hereby canceled. However, Applicant reserves the right to later file continuations or divisions having claims directed to the non-elected inventions.

Objections to the Drawings

The drawings were objected to as failing to comply with 37 CFR 1.84(p)(4) because the resist layer of Figure 1A has been misnumbered with reference character "119" instead of reference character "118" and the resist stack in Figure 1A has been misnumbered with reference character "101" instead of reference character "100". The Applicant appreciates the Examiner's thorough review of the drawings, and includes a replacement set of drawings in this response, correcting the inadvertent errors.

Objections to the Specification

The specification was objected to because of the use of the trademark Aleg® 820. The specification is amended herein to correct these, and other, inadvertent errors. No new matter has been added by these specification changes. Applicant thanks the Examiner for finding these errors.

§112 Rejection of the Claims

Claims 3-6, 10-11, 14-20, 22-23, 31-34 and 42 were rejected under 35 U.S.C. § 112, first paragraph, as lacking adequate description or enablement, in particular, the use of concentration ratios. Applicant respectfully traverses this rejection.

Applicant respectfully submits that the specification at page 9 line 30, page 10 line 4, and page 12 line 27 indicates that the “presence by volume” of an aqueous solution is the ratio indicated, as noted by the Examiner in the last sentence of paragraph 8 on page 4. To establish a *prima facie* case of lack of written description under § 112, each one of four elements must be demonstrated. Viz, (1) the application does not reasonably describe or convey the concepts (2) to one of ordinary skill in the art (3) at the time of filing the patent application (4) of the claimed invention. None of the elements has been shown in the outstanding Office Action. Therefore, since a *prima facie* case of lack of written description has not been made, and because the requisite information has indeed been disclosed in the Application as-filed, it is respectfully submitted that the specification is proper under 35 USC § 112, first paragraph. Thus, Applicant submits that the description is adequate for one of ordinary skill in the art to practice the invention without undue experimentation, and requests that this rejection under the first paragraph of 35 U.S.C. § 112 be withdrawn.

Claims 3-6, 10-38 and 42 were rejected under 35 U.S.C. § 112, second paragraph, for indefiniteness. The first portion of this rejection, specifically the objection to the use of a concentration ratio, engenders the same response as given immediately above with reference to the 35 U.S.C. § 112, first paragraph rejection, and is respectfully traversed. The second portion of this rejection, specifically that made to the Markush group language, has been addressed by claim amendments contained herein. In view of the above, Applicant submits that the claims, as

amended, are proper and requests that this rejection under the second paragraph of 35 U.S.C. § 112 be withdrawn.

§103 Rejection of the Claims

Claims 1-4, 7-14, 16-21, 24-35, 37 and 39-41 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. (U.S. 7,064,078) in view of Szwejkowski et al. (U.S. 5,147,499). Applicant respectfully traverses this rejection.

The cited reference of Liu discloses the use of a process that uses a first photoresist mask to etch a first pattern on an amorphous carbon hard mask, remove the first photoresist, and then a second photoresist mask to etch a second pattern on the hard mask, remove the second photoresist, and then etches the combined pattern into the substrate. Applicant is unable to find any indication in the cited reference of Liu, or even a suggestion of a problem with residual photoresist material remaining after the removal of the photoresist.

The cited Szwejkowski reference discloses a method of removing a silicon and oxide containing sidewall material 26, which is inadvertently formed during the anisotropic etch, and over etch, which formed the polysilicon 20 into a polysilicon line 28. The sidewall material 26 is formed of silicon and oxides, and is not suggested to be a residual portion of the photoresist 32, as discussed at least at column 1, lines 32-42, and column 2, lines 4-11. The sidewall material 26 is stated to conventionally be removed by HF, and is stated to be formed of silicon and oxides (see col. 2, lines 29-38; col. 3, lines 5-11) and is stated to be “not purely polysilicon” (see col. 3, line 8). Applicant can find nothing in the cited reference suggesting that the silicon and oxide film 26 is residual photoresist, and the suggested methods, such a HF etching, are directed towards dielectric etch, and would have no clear affect on residual photoresist regions as in the present application.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*removing the resist; and surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and to the substrate* ...”, as recited in independent claim 1, as amended herein, from which claims 2-4 depend. Since neither cited reference containing any suggestion of residual resist, or of removing the residue, the suggested combination does not contain the above noted feature.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*surface treating the substrate to remove residual resist* ...”, as recited in independent claim 7, from which claims 8-11 depend. As noted above, neither cited reference containing any suggestion of residual resist, or of removing the residue, and thus are inappropriate references.

Applicant submits that independent claims 16, 21, 24, 29, 35, 37 and 39 recite “...*surface treating the substrate to remove residual photoresist* ...”, which is not suggested by the combination of references. The remaining claims depend from these independent claims.

The dependent claims are believed to be patentable at least as depending from patentable base claims as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the failure of the reference to describe or suggest at least removing residual photoresist, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 5-6, 11, 15-16, 25-29 and 31-34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. and Szejewski et al. as applied to claims 1-4, 7-14, 16-21, 24-35, 37 and 39-41 above, and further in view of Chen et al. (U.S. Publication 2005/0026435). Applicant respectfully traverses this rejection.

The cited references of Liu and Szejewski lack the features discussed above with reference to the previous rejection. Chen is used in the outstanding Office Action to show that solutions of ammonium hydroxide and peroxide are known. Applicant respectfully submits that the addition of Chen does nothing to cure the above noted failure of the other references to suggest a surface treatment to remove residual photo resist material.

Specifically, Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*removing the resist; and surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and to the substrate* ...”, as recited in independent claim 1, as amended herein, from which claim 5 depends. Since neither cited reference containing any suggestion of residual resist, or of removing the residue, the suggested combination does not contain the above noted feature.

Similar reasoning is believed to pertain to the remaining claims in question, which are thereby held to be in patentable condition. In view of the above discussion, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 21-23, 37-38 and 42 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. and Szwejkowski et al. as applied to claims 1-4, 7-14, 16-21, 24-35, 37 and 39-41 and further in view of Fang et al. (U.S. Publication 2005/0161338). Applicant respectfully traverses this rejection.

The cited reference of Liu and Szwejkowski lack the features discussed above with reference to the previous rejection. Fang is used in the outstanding Office Action to show that it is known to use solutions including sulfuric acid and citric acid. Applicant respectfully submits that the addition of Fang does nothing to cure the above noted failure to suggest a surface treatment to remove residual photo resist material.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...a photoresist layer disposed over the at least one antireflective coating; and surface treating the substrate to remove residual photoresist ...”, as recited in independent claim 21, as amended herein. The cited references, whether taken alone or in any combination, do not suggest a surface treatment to remove residual photoresist, and thus can not provide the suggestion to one of ordinary skill in the art to obtain the claimed invention.

Similar reasoning is believed to pertain to the remaining claims in question, which are believed to be in patentable condition, as amended herein. In view of the above discussion, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Provisional Double Patenting Rejection

Claims 12-23 and 35-38 were provisionally rejected under 35 U.S.C. 101 of double patenting over claims 1-12 and 24-27 of co-pending Application No. 11/494,056.

Applicant does not admit that the claims are obvious in view of co-pending Application No. 11/494,056. However, a Terminal Disclaimer in compliance with 37 C.F.R. 1.321(b)(iv) will be considered to obviate this rejection upon allowance of the recited claims in the co-pending application.

Claims 1-11, 24-34 and 39-42 were provisionally rejected under a non-statutory obviousness-type double patenting rejection, over claims 13-16, 19-20 and 23-34 of co-pending Application No. 11/494,056

Applicant does not admit that the claims are obvious in view of co-pending Application No. 11/494,056. However, a Terminal Disclaimer in compliance with 37 C.F.R. 1.321(b)(iv) will be considered to obviate this rejection upon allowance of the recited claims in the co-pending application.

Reservation of Rights

In the interest of clarity and brevity, Applicant may not have addressed every assertion made in the Office Action. Applicant's silence regarding any such assertion does not constitute any admission or acquiescence. Applicant reserves all rights not exercised in connection with this response, such as the right to challenge or rebut any tacit or explicit characterization of any reference or of any of the present claims, the right to challenge or rebut any asserted factual or legal basis of any of the rejections, the right to swear behind any cited reference such as provided under 37 C.F.R. § 1.131 or otherwise, or the right to assert co-ownership of any cited reference. Applicant does not admit that any of the cited references or any other references of record are relevant to the present claims, or that they constitute prior art. To the extent that any rejection or assertion is based upon the Examiner's personal knowledge, rather than any objective evidence of record as manifested by a cited prior art reference, Applicant timely objects to such reliance on Official Notice, and reserves all rights to request that the Examiner provide a reference or affidavit in support of such assertion, as required by MPEP § 2144.03. Applicant reserves all rights to pursue any cancelled claims in a subsequent patent application claiming the benefit of priority of the present patent application, and to request rejoinder of any withdrawn claim, as required by MPEP § 821.04.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney, David Suhl, at 508-865-8211, or the undersigned to facilitate prosecution of this application. If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

KEVIN SHEA ET AL.

By their Representatives,

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
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Date March 7, 2007

By / Mark V. Muller /
Mark V. Muller
Reg. No. 37,509

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Mail Stop Amendment, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 7 day of March 2007.

Kate Gannon

Name

Kate Gannon

Signature



EXPEDITED PROCEDURE – EXAMINING GROUP 1756

S/N 10/788,889

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Kevin Shea et al.	Examiner:	Caleen O Sullivan
Serial No.:	10/788,889	Group Art Unit:	1756
Filed:	February 27, 2004	Docket No.:	303.867US1
Title:	SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND SURFACE TREATMENT COMPOSITIONS USED THEREFOR		

AMENDMENT & RESPONSE UNDER 37 C.F.R. 1.116

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In response to the Final Office Action mailed May 2, 2007, please amend the application as follows:

IN THE CLAIMS

Please amend the claims as follows.

1. (Currently Amended) A process comprising:
patterning a carbon-containing hard mask over a substrate with a resist;
removing the resist; and
surface treating the substrate to remove residual resist disposed in contact with the substrate under conditions that are selective to the hard mask and to the substrate.
2. (Original) The process of claim 1, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution.
3. (Currently Amended) The process of claim 1, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio from about 100:3:2 to about 5:1:2.
4. (Currently Amended) The process of claim 1, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio from about 5:1:1 to about 5:1:2.
5. (Currently Amended) The process of claim 1, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio from about 100:1:2 to about 100:3:2.

6. (Currently Amended) The process of claim 1, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes using an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio from about 100:1:1 to about 100:3:3.

7. (Original) A process comprising:
patterning a carbon-containing hard mask over a substrate with a resist; and
surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and to the substrate, wherein surface treating includes an aqueous ammonium hydroxide and hydrogen peroxide solution that is applied in a time range from about 2 minutes to about 45 minutes.

8. (Original) The process of claim 7, wherein surface treating includes surface treating with an aqueous ammonium hydroxide and hydrogen peroxide solution that is applied in a temperature range from about room temperature to about 70° C.

9. (Original) The process of claim 7, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, wherein surface treating includes surface treating with an aqueous ammonium hydroxide and hydrogen peroxide solution that is applied in a temperature range from about room temperature to about 70° C.

10. (Currently Amended) The process of claim 7, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, wherein surface treating includes:
surface treating with an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio from about 5:1:1 to about 100:3:2; and
a temperature range from about room temperature to about 70° C.

11. (Currently Amended) The process of claim 7, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, wherein surface treating includes:

surface treating with an aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio of about 100:3:2;

a time of about 10 minutes; and

a temperature of about 55° C.

12. – 23. (Canceled)

24. (Previously Presented) A process comprising:

patterning a carbon-containing hard mask with a resist over a substrate; and

surface treating the substrate to remove residual resist under conditions that are selective to leaving the carbon-containing hard mask, wherein surface treating includes surface treating with a rinse solution selected from aqueous ammonium hydroxide and hydrogen peroxide solution, aqueous sulfuric acid and citric acid solution, aqueous sulfuric acid and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, ozone with dilute hydrogen fluoride, and combinations thereof.

25. (Previously Presented) The process of claim 24, wherein surface treating includes surface treating with a rinse solution:

in a majority proportion aqueous ammonium hydroxide and hydrogen peroxide solution; and

in a minority proportion at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride.

26. (Previously Presented) The process of claim 24, wherein surface treating includes surface treating with a rinse solution:

in a majority proportion aqueous ammonium hydroxide and hydrogen peroxide solution;

in a minority proportion at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride; and the process further including:

surface treating for a time range from about 2 minutes to about 45 minutes.

27. (Previously Presented) The process of claim 24, wherein surface treating includes surface treating with a rinse solution:

in a majority proportion aqueous ammonium hydroxide and hydrogen peroxide solution;

in a minority proportion at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride; and the process further including:

surface treating for a temperature range from about room temperature to about 70° C.

28. (Previously Presented) The process of claim 24, wherein surface treating includes surface treating with a rinse solution:

in a majority proportion aqueous ammonium hydroxide and hydrogen peroxide solution;

in a minority proportion at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride; and the process further including:

surface treating for a time range from about 2 minutes to about 45 minutes, and

for a temperature range from about room temperature to about 70° C.

29. (Previously Presented) A process comprising:

patterning a carbon-containing hard mask with a resist over a substrate; and

surface treating the substrate to remove residual resist under conditions that are selective to leaving the carbon-containing hard mask, wherein surface treating includes:

in a plurality proportion aqueous ammonium hydroxide and hydrogen peroxide solution; and

in a minority proportion at least two of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride.

30. (Original) The process of claim 29, wherein surface treating includes surface treating for a time range from about 2 minutes to about 45 minutes, and a temperature range from about room temperature to about 70° C.

31. (Currently Amended) The process of claim 29, wherein surface treating includes surface treating with a rinse solution:

the plurality proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio of about 100:3:2; and

the minority proportion including aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio of about 5:1:1.

32. (Currently Amended) The process of claim 29, wherein surface treating includes surface treating with a rinse solution:

the plurality proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio of about 100:3:2;

a first minority proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio of about 5:1:1; and

a second minority proportion of at least one solution selected from aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride.

33. (Currently Amended) The process of claim 29, wherein surface treating includes the rinse solution:

a plurality proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio of about 100:3:2;

a first minority proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio of about 5:1:1;

a second minority proportion of at least one solution selected from aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride; and

wherein the second minority proportion is less than the first minority proportion.

34. (Currently Amended) The process of claim 29, wherein surface treating includes the rinse solution:

a plurality proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio of about 100:3:2;

a first minority proportion of aqueous ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ volume concentration ratio of about 5:1:1;

a second minority proportion of at least one solution selected from aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride; and

wherein the second minority proportion is less than the first minority proportion; and the process further including:

surface treating a time range from about 2 minutes to about 45 minutes; and

a temperature range from about room temperature to about 70° C.

35. – 38. (Canceled)

39. (Currently Amended) A process comprising:

patterning a carbon-containing hard mask over a substrate with a photoresist;

removing the photoresist;

surface treating the substrate to remove residual photoresist in contact with the substrate under conditions that are selective to the hard mask and to the substrate; and

dry etching the substrate through the hard mask.

40. (Original) The process of claim 39, wherein the carbon-containing hard mask includes amorphous carbon, and wherein surface treating includes surface treating using an aqueous ammonium hydroxide and hydrogen peroxide solution.

41. (Original) The process of claim 39, wherein patterning the carbon-containing hard mask includes patterning amorphous carbon, and wherein surface treating includes surface treating using an aqueous ammonium hydroxide and hydrogen peroxide solution, wherein surface treating includes surface treating for a time range from about 2 minutes to about 45 minutes, and wherein surface treating also includes surface treating at a temperature range from about room temperature to about 70° C.

42. (Currently Amended) The process of claim 39, wherein surface treating includes surface treating using an aqueous sulfuric acid and citric acid solution in an H₂O:H₂SO₄:C₆H₄O₇ volume concentration ratio of about 100:3:2 to about 100:2:2, a time of about 10 minutes, and a temperature of about 55° C.

43. – 50. (Canceled)

REMARKS

This paper responds to the Office Action mailed on May 2, 2007.

Claims 1, 3-6, 10-11, 31-34, 39 and 42 are amended, claims 12-23 and 35-38 are canceled without prejudice or waiver of patentable content, and no claims are added; as a result, claims 1-11, 24-34 and 39-42 are now pending in this application.

§112 Rejection of the Claims

Claims 3-6, 10-11, 14-15, 16-20, 22-23, 31-34 and 42 were rejected under 35 U.S.C. § 112, first paragraph, as lacking adequate description or enablement. Applicant respectfully disagrees with this rejection for the reasons provided in the prior response, but in order to advance the prosecution of this application, Applicant has amended claims 3-6, 10-11, 31-34 and 42 to clarify that the concentration ratio is a volume concentration ratio, as the Examiner noted in the previous Office Action dated December 29, 2006 in paragraph 8. Applicant has cancelled claims 14-15, 16-20, and 22-23 without prejudice or waiver of patentable subject matter, and retains the right to resubmit these claims in subsequent continuation or divisional applications. Applicant requests that this rejection be withdrawn in view of the claim amendments and cancellations.

Claims 3-6, 10-38 and 42 were rejected under 35 U.S.C. § 112, second paragraph, for indefiniteness, specifically whether the concentration ratios recited are volume, weight or molar concentrations. Applicant again respectfully disagrees with this rejection regarding the concentration ratios, but in order to advance the prosecution of this application, Applicant has amended the claims to clarify that a volume concentration ratio is meant, as the Examiner assumed in the previous Office Action. Applicant requests that this rejection be withdrawn in view of the claim amendments.

§103 Rejection of the Claims

Claims 1-4, 7-14, 16-21, 24-35, 37 and 39-41 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. (U.S. 7,064,078) in view of Szwejkowski et al. (U.S. 5,147,499). Applicant respectfully traverses this rejection. Claims 12-14, 16-21, 35 and 37 are canceled without prejudice herein.

Liu discloses a process that uses a first photoresist mask 106 to etch a first pattern 108 in an amorphous carbon hard mask 104, then entirely removing the first photoresist 106 (see figure 2C). Then a second different photoresist mask 110 is patterned to form and to etch a second pattern 112 on the same hard mask 104, and then completely removing the second photoresist (see figure 2E). Then the combined pattern in the hard mask 104 of the first and the different second masks (108 and 114) is used to etch a pattern 116 into the substrate 102. Liu discloses a non carbon cap layer 205 disposed on the amorphous hard mask layer 204, that is used to “protect the amorphous carbon layer during processing steps such as the removal of the photoresist” (col. 5, lines 65-66), and may be used as an anti-reflection coating.

Applicant is unable to find any indication in Liu of a problem with residual photoresist material remaining after the removal of the photoresist. Liu does suggest *patterning a carbon-containing hard mask over a substrate with a resist; removing the resist*, but does not suggest either a resist stack or the use of a single resist layer, and has no suggestion of any sort of *surface treating the substrate to remove residual resist under conditions that are selective to the hard mask and to the substrate*, since there is nothing related to residual resist in Liu, or any recognition of such an issue existing, as admitted by the Examiner on page 5, second paragraph of the outstanding Office Action.

Szwejkowski discloses a method of removing a silicon and oxide containing sidewall material 26, inadvertently formed during polysilicon anisotropic etch forming the polysilicon layer 20 into polysilicon line 28. The sidewall material 26 is formed of silicon and oxides, and as discussed at least at column 1, lines 32-42, and column 2, lines 4-11, is not suggested to be a residual portion of the photoresist 32, or to have any relationship to any photoresist or organic polymer material. Sidewall material 26 is stated to conventionally be removed by HF, and is

stated to be formed of silicon and oxides (see col. 2, lines 29-38; col. 3, lines 5-11) and “not purely polysilicon” (see col. 3, line 8), clearly indicating to one of ordinary skill in the art that this is not a photoresist residue. Applicant can find nothing in the cited reference suggesting that the silicon and oxide film 26 is residual photoresist, and the suggested methods, such as HF etching, are clearly directed towards dielectric materials, and would have no affect on residual photoresist, such as found in the present application.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*patterning a carbon-containing hard mask over a substrate with a resist; removing the resist; and surface treating the substrate to remove residual resist disposed in contact with the substrate under conditions that are selective to the hard mask and to the substrate...*”, as recited in independent claim 1, as amended herein, from which claims 2-6 depend. Neither reference suggests a photoresist residue, and certainly not a photoresist residue in contact with the substrate.

For similar reasons, Applicant respectfully submits that the remaining independent claims are also patentable over the suggested combination of references. The dependent claims are believed to be patentable at least as depending from patentable base claims as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the above noted claim amendments, and discussion of the failure of the references to describe or suggest at least removing residual photoresist, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 5-6, 11, 15-16, 25-29 and 31-34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. and Szwejkowski et al. as applied to claims 1-4, 7-14, 16-21, 24-35, 37 and 39-41 above, and further in view of Chen et al. (U.S. Publication 2005/0026435). Claims 15-16 are cancelled without prejudice herein.

The cited references of Liu and Szwejkowski lack the features discussed above with reference to the previous rejection. Chen is used in the outstanding Office Action to show that solutions of ammonium hydroxide and peroxide are known. Applicant respectfully submits that

the addition of Chen does nothing to cure the above noted failure of the other references to suggest a surface treatment to remove residual photo resist material.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*patterning a carbon-containing hard mask over a substrate with a resist; removing the resist; and surface treating the substrate to remove residual resist disposed in contact with the substrate under conditions that are selective to the hard mask and to the substrate...*”, as recited in independent claim 1, as amended herein, from which claims 5-6 depend. Neither reference suggests a photoresist residue, nor a photoresist residue in contact with the substrate.

For similar reasons, Applicant respectfully submits that the remaining independent claims are also patentable over the suggested combination of references. The dependent claims are believed to be patentable at least as depending from patentable base claims as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the above noted claim amendments, and discussion of the failure of the references to describe or suggest at least removing residual photoresist, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 21-23, 37-38 and 42 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. and Szwejkowski et al. as applied to claims 1-4, 7-14, 16-21, 24-35, 37 and 39-41 and further in view of Fang et al. (U.S. Publication 2005/0161338). Claims 21-23 and 37-38 are canceled without prejudice herein.

The cited reference of Liu and Szwejkowski lack the features discussed above with reference to the previous rejection. Fang is used in the outstanding Office Action to show that it is known to use solutions including sulfuric acid and citric acid. Applicant respectfully submits that the addition of Fang does nothing to cure the above noted failure to suggest a surface treatment to remove residual photo resist material.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*patterning a carbon-containing hard mask*

over a substrate with a photoresist; removing the photoresist; surface treating the substrate to remove residual photoresist in contact with the substrate under conditions that are selective to the hard mask and to the substrate; and dry etching the substrate through the hard mask...”, as recited in independent claim 39, as amended herein, from which claim 42 depends. The cited references, whether taken alone or in any combination, do not suggest a surface treatment to remove residual photoresist or photoresist in contact with the substrate. Thus, the suggested combination of references, even if there were proper motivation shown to make the combination, still does not suggest at least the above recited feature of the claims. In view of the above discussion and claim amendments, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Provisional Double Patenting Rejection

Claims 12-23 and 35-38 were provisionally rejected under 35 U.S.C. 101 of double patenting over claims 1-12 and 24-27 of co-pending Application No. 11/494,056. Claims 12-23 and 35-38 are cancelled without prejudice herein, and Applicant requests this rejection be withdrawn.

Claims 1-11, 24-34 and 39-42 were provisionally rejected under a non-statutory obviousness-type double patenting rejection, over claims 13-16, 19-20 and 23-34 of co-pending Application No. 11/494,056

Applicant does not admit that the claims are obvious in view of co-pending Application No. 11/494,056. However, a Terminal Disclaimer in compliance with 37 C.F.R. 1.321(b)(iv) will be considered to obviate this rejection upon indication of allowance of the claims.

Reservation of Rights

In the interest of clarity and brevity, Applicant may not have addressed every assertion made in the Office Action. Applicant's silence regarding any such assertion does not constitute any admission or acquiescence. Applicant reserves all rights not exercised in connection with this response, such as the right to challenge or rebut any tacit or explicit characterization of any

reference or of any of the present claims, the right to challenge or rebut any asserted factual or legal basis of any of the rejections, the right to swear behind any cited reference such as provided under 37 C.F.R. § 1.131 or otherwise, or the right to assert co-ownership of any cited reference. Applicant does not admit that any of the cited references or any other references of record are relevant to the present claims, or that they constitute prior art. To the extent that any rejection or assertion is based upon the Examiner's personal knowledge, rather than any objective evidence of record as manifested by a cited prior art reference, Applicant timely objects to such reliance on Official Notice, and reserves all rights to request that the Examiner provide a reference or affidavit in support of such assertion, as required by MPEP § 2144.03. Applicant reserves all rights to pursue any cancelled claims in a subsequent patent application claiming the benefit of priority of the present patent application, and to request rejoinder of any withdrawn claim, as required by MPEP § 821.04.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney David Suhl at (508) 865-8211, or the undersigned attorney at (612) 349-9587 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

KEVIN SHEA ET AL.

By their Representatives,

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.

P.O. Box 2938


Minneapolis, MN 55402

(612) 349-9587

Date

28 June '07

By


Timothy B. Clise

Reg. No. 40, 957

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being filed using the USPTO's electronic filing system EFS-Web, and is addressed to: Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 28 day of June 2007.

Name

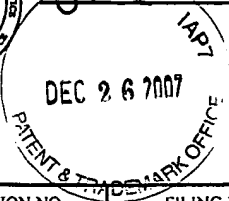
KATE GANNON

Signature

Kate G



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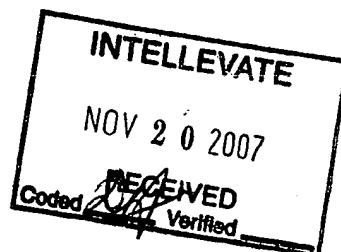


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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/168,023	06/28/2005	Kevin Shea	P 303.898US1	9578
21186 7590 11/14/2007 SCHWEGMAN, LUNDBERG & WOESSNER, P.A. P.O. BOX 2938 MINNEAPOLIS, MN 55402			EXAMINER ANGADI, MAKI A	
			ART UNIT 1792	PAPER NUMBER
			MAIL DATE 11/14/2007	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.



Schwegman Lundberg
& Woessner P.A.

NOV 20 2007

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Office Action Summary	Application No.		Applicant(s)	
	11/168,023		SHEA, KEVIN	
	Examiner		Art Unit	
	Maki A. Angadi		1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 September 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-3, 8, 12-19 and 22-26 are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986).

As to *claim 1*, Chen discloses a method of forming a patterned polysilicon layer (paragraph 0026) in a single etch solution consisting of: (a) exposing a substrate having a photo-resist pattern on a polysilicon layer (Fig.2B, paragraph 0043, Fig.2E, paragraph 0045) to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide (TMAH) and water at a pre-selected temperature and first concentration (paragraph 0031, paragraph 0045).

Chen is silent about the removal of the substrate from the etch solution after a pre-selected time period. However, Wolf discloses the fixed time of etching in wet etching process (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the time of etching in the process cited by Chen because Wolf illustrates that the time of etching would be determined by the type of etchant and the material being etched (pages 516-517).

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As to claim 2, Chen is silent about the use of ammonium hydroxide in the etch solution. However, Wolf discloses the use of ammonium hydroxide in the etch solution and removing the substrate from the etch solution after a pre-selected time period (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select ammonium hydroxide in the etching solution in the process cited by Chen because Wolf illustrates that ammonium hydroxide removes residual organic contaminants from certain metals (page 516).

Chen is silent about the removal of the substrate from the etch solution after a pre-selected time period. However, Wolf discloses the fixed time of etching in wet etching process (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the time of etching in the process cited by Chen because Wolf illustrates that the time of etching would be determined by the type of etchant and the material being etched (pages 516-517).

As to claim 3, Chen discloses that the tetra methyl ammonium hydroxide temperature is in a range of about 5°C to 50°C, which is slightly lower than the range (60-90°C) cited by the applicant. However, Wolf discloses that the etching solution could be heated to about 75-80°C. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify temperature of the etching solution used by Chen because Wolf illustrates

that the etching parameters such as temperature, time and concentration would determine etch rate (page 514-515).

As to claim 8 and 19, Chen discloses that the concentration of TMAH is in the range 1-10 wt% in de-ionized water (paragraph 0031), which is in the overlapping range cited by the applicant.

As to claim 12-13 and 22-23, Chen discloses the use of TMAH in the etching solution but fails to disclose the presence of a percentage of ammonium hydroxide in the etching mixture. However, Wolf suggests the use of ammonium hydroxide for the wet etching process (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine ammonium hydroxide and TMAH in the etching solution of Chen because Wolf teaches that etchants can be combined to improve etch selectivity.

As to claim 14-16 and 24-26, Chen discloses the etching of the silicon oxide (paragraph 0043), polysilicon layer (paragraph 0045) and doped oxide layer (paragraph 0046) but is silent about the etch rate. According to Wolf, the etch rate is affected by large number of parameters such as, type of feed gas, power, and pressure in dry etching (pages 546-547) and type of etchant, temperature of etchant and surface contaminants (pages 521-523). Therefore, it would have been obvious to one of ordinary skill in the art at the time the

invention was made to select etch rate in the process suggested by Chen because Wolf discloses that the etch rate influences both isotropic and anisotropic etching and control of edge profiles (pages 551-552).

As to claim 17, Chen discloses a method of etching polysilicon consisting of TMAH (paragraph 0031) but fails to disclose the presence of ammonium hydroxide in the etching solution. However, Wolf discloses the use of ammonium hydroxide in the etch solution and removing the substrate from the etch solution after a pre-selected time period (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select ammonium hydroxide in the etching solution in the process cited by Chen because Wolf illustrates that ammonium hydroxide removes residual organic contaminants from certain metals (page 516).

Chen is silent about the removal of the substrate from the etch solution after a pre-selected time period. However, Wolf discloses the fixed time of etching in wet etching process (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the time of etching in the process cited by Chen because Wolf illustrates that the time of etching would determine the type of etchant and the material being etched (pages 516-517).

As to *claim 18*, Chen discloses that the tetra methyl ammonium hydroxide temperature is in a range of about 5°C to 50°C, which is slightly lower than the range (60-90°C) cited by the applicant. However, Wolf discloses that the etching solution could be heated to about 75-80°C. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify temperature of the etching solution used by Chen because Wolf illustrates that the etching parameters such as temperature, time and concentration would determine etch rate (page 514-515).

Claim Rejections - 35 USC § 103

3. Claims 5 and 6 are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986) as applied to claim 1, in further view of Li (US Patent No. 5, 783,495).

As to *claim 5*, Chen is silent about the single wafer spinning vacuum chuck with TMAH dispensing nozzle. However, Li discloses a process chamber that includes a provision for TMAH dispensing nozzle (31) and wafer spinning vacuum chuck (10) (Fig.5) (col.7, lines 52-57, col.8, lines 18-24). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process chamber used by Chen because Li illustrates process chamber (Fig.5) with a spinning vacuum chuck would control the flow of acid, deionized water and the carrier gas at a steady rate (col.8, lines1-5).

As to claim 6, Chen is silent about the temperature of the droplets. However, Li discloses the temperature of the cleaning in the range 40°C to 100°C (col.5, lines 48-50). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the droplet temperature of the cleaning fluid in the process cited by Chen because Li illustrates that the cleaning is effective and long lasting at the temperature range 40°C to 100°C (col.5, lines 50-51).

Claim Rejections - 35 USC § 103

4. Claims 3, 7, 9 and are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986) as applied to claim 1, in further view of Schoeppel (US Patent No. 5,039,349).

As to claim 3, Chen is silent about the temperature of the TMAH solution. However, Schoeppel discloses that the temperature of the TMAH containing solution is in the range 85-90°C which overlaps the range cited by the applicant (col.7, lines 7-9). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the temperature of the etching solution as in the case of Chen because Schoeppel illustrates that at elevated temperatures the deionized water itself is very aggressive cleaner (col.7, lines 7-10).

As to claim 7, Chen is silent about the chemical etch solution consisting of an open bath having temperature control. However, Schoeppel discloses the use of RCA type bath around 50°C (col.2, lines 26-28). In addition, it is standard laboratory practice to use a temperature controller to maintain the temperature of the bath. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select temperature bath and the temperature controller in the process used by Chen because Schoeppel illustrates that it is important to maintain bath temperature to remove organic contaminants from the wafer surface.

As to claim 9 and 20, Chen discloses that the concentration of TMAH is in the range 1 to about 10-wt% which is close to the range cited by the applicant. Chen is silent about the pH of the solution. However, Schoeppel discloses that the pH of the solution is in the range 11-13 (col.7, lines 10-11). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the pH of the solution in the process used by Chen because Schoeppel illustrates that the efficacy of the etching solution is dependent on the pH of the solution and it is replenished when it falls below 11 (col.7, lines 13-15).

Claim Rejections - 35 USC § 103

5. Claims 10, 11 and 21 are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era,

Lattice Press (1986) as applied to claim 1, in further view of Hardy (US Patent No. 6,238,592).

Chen does not disclose the presence of ammonium hydroxide in the etching solution. However, Hardy discloses the presence of ammonium hydroxide as a complexing agent in the etching solution and its concentration in the range 0.01 to 50 wt% in deionized water (col.8, lines 63-65), which is in the overlapping range cited by the applicant.

Response to Arguments

6. Applicant's arguments filed on 9/18/2007 have been fully considered but they are not persuasive.

(a) *With respect to claim 1*, applicants' arguments on pages 8-9 of the reply asserting that the combined reference of Chen and Wolf do not teach the presence of photo-resist on the polysilicon layer at the time the etching is performed is not convincing.

Chen discloses the wet etch process operates by depositing a layer of silicon-containing material (such as polysilicon), masking it with a patterned resist layer (paragraph 0026). Chen further explains that the masking layer is stripped from the layer of silicon-containing material (paragraph 0030) and the layer of silicon-containing material is etched with an etching process using tetramethyl ammonium hydroxide (TMAH) (paragraph 0031). Chen illustrates the presence of

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photoresist layer (281) on the polysilicon layer (285) (Fig.2E) at time the time etching is performed (paragraph 0043 and 0045). It is within the scope of one who is skilled in the art at the time the invention was made to select the sequence of wet etching steps in the fabrication of memory devices as is illustrated by Chen in various embodiments (paragraph 0010-0014). One who is skilled in the art at the time of invention should be able to combine the teachings of Chen and Wolf and the use of common sense selection (CSS) test to expose a substrate having a photoresist pattern on a polysilicon layer to a liquid chemical etch solution (see *In KSR v. Teleflex*, 2001).

(b) *With respect to claims 3, 5-11 and 21*, the combined teachings of Chien, Wolf, Li, Schoeppel and Hardy meet all the limitation defined in these claims (see arguments on pages 2-9 above).

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will

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the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Itoh (US Patent No. 4,729,941) discloses photoresist processing solution with quaternary ammonium hydroxide.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maki A. Angadi whose telephone number is 571-272-8213. The examiner can normally be reached on 8 AM to 4.30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

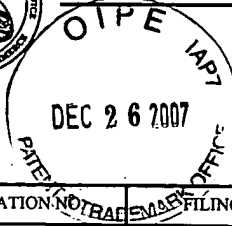
Dr. Maki Angadi
Examiner,
Art Unit 1765

NADINE NORTON
SUPERVISORY PATENT EXAMINER





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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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11/168,023

06/28/2005

Kevin Shea

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9578

21186 7590 03/30/2007

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.

P.O. BOX 2938

MINNEAPOLIS, MN 55402

EXAMINER

ANGADI, MAKI A

ART UNIT

PAPER NUMBER

1765

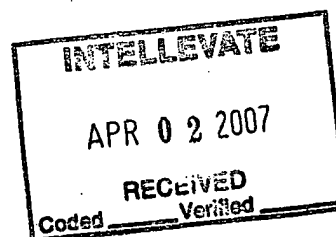
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DELIVERY MODE

03/30/2007

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Please find below and/or attached an Office communication concerning this application or proceeding.



Schwegman Lundberg
Woessner & Kluth P.A.

APR 02 2007

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Advisory Action Before the Filing of an Appeal Brief	Application No.	Applicant(s)	
	11/168,023	SHEA, KEVIN	
	Examiner	Art Unit	
	Maki A. Angadi	1765	

--The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

THE REPLY FILED 05 March 2007 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

1. ☒ The reply was filed after a final rejection, but prior to or on the same day as filing a Notice of Appeal. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance; (2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114. The reply must be filed within one of the following time periods:

- a) ☒ The period for reply expires 3 months from the mailing date of the final rejection.
b) ☐ The period for reply expires on: (1) the mailing date of this Advisory Action, or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

Examiner Note: If box 1 is checked, check either box (a) or (b). ONLY CHECK BOX (b) WHEN THE FIRST REPLY WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☐ The proposed amendment(s) filed after a final rejection, but prior to the date of filing a brief, will not be entered because
- (a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below);
(b) ☐ They raise the issue of new matter (see NOTE below);
(c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or
(d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

NOTE: _____. (See 37 CFR 1.116 and 41.33(a)).

4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).
5. ☐ Applicant's reply has overcome the following rejection(s): _____.
6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).

7. ☒ For purposes of appeal, the proposed amendment(s): a) ☐ will not be entered, or b) ☐ will be entered and an explanation of how the new or amended claims would be rejected is provided below or appended.

The status of the claim(s) is (or will be) as follows:

Claim(s) allowed: _____

Claim(s) objected to: _____

Claim(s) rejected: 1-26

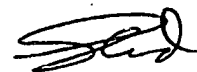
Claim(s) withdrawn from consideration: _____

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ The affidavit or other evidence filed after a final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).
9. ☐ The affidavit or other evidence filed after the date of filing a Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing a good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).
10. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

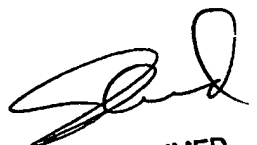
REQUEST FOR RECONSIDERATION/OTHER

11. ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because:
See Continuation Sheet.
12. ☐ Note the attached Information Disclosure Statement(s). (PTO/SB/08) Paper No(s). _____
13. ☐ Other: _____



SHAMIM AHMED
PRIMARY EXAMINER

Continuation of 11. does NOT place the application in condition for allowance because: With respect to claim 1, applicants' arguments on page 8-9 of the reply that the reference of Chen does not have photo-resist on the polysilicon layer at the time the etching is performed is not convincing. Chen discloses the wet etch process operated by depositing a layer of silicon-containing material (such as polysilicon), masking it with a patterned resist layer (paragraph 0026). Chen further explains that the masking layer is stripped from the layer of silicon-containing material (paragraph 0030) and the layer of silicon-containing material is etched with an etching process using tetramethyl ammonium hydroxide (TMAH) (paragraph 0031)..



SHAMIM AHMED
PRIMARY EXAMINER

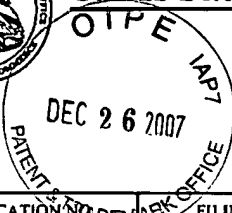


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4_A_T_13115

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/168,023	06/28/2005	Kevin Shea	303.898US1	9578

21186 7590 01/25/2007
SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER

ANGADI, MAKI A

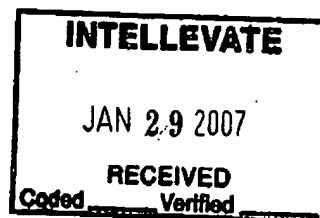
ART UNIT PAPER NUMBER

1765

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/25/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.



Schwegman Lundberg
Woessner & Kluth P.A.

JAN 29 2007

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Office Action Summary	Application No.	Applicant(s)	
	11/168,023	SHEA, KEVIN	
	Examiner	Art Unit	
	Maki A. Angadi	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 December 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>12/18/2006</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election of claims 1-26 in the reply filed on December 18, 2006 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)). Claims 27-40 withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected Group II and III, there being no allowable generic or linking claim.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-3, 8, 12-19 and 22-26 are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986).

As to claim 1, Chen discloses a method of forming a patterned polysilicon layer (paragraph 0026) in a single etch solution consisting of: (a) exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide (TMAH) and water at a pre-selected temperature and first concentration (paragraph 0031).

Chen is silent about the removal of the substrate from the etch solution after a pre-selected time period. However, Wolf discloses the fixed time of etching in wet etching process (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the time of etching in the process cited by Chen because Wolf illustrates that the time of etching would be determined by the type of etchant and the material being etched (pages 516-517).

As to claim 2, Chen is silent about the use of ammonium hydroxide in the etch solution. However, Wolf discloses the use of ammonium hydroxide in the etch solution and removing the substrate from the etch solution after a pre-selected time period (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select ammonium hydroxide in the etching solution in the process cited by Chen because Wolf illustrates that ammonium hydroxide removes residual organic contaminants from certain metals (page 516).

Chen is silent about the removal of the substrate from the etch solution after a pre-selected time period. However, Wolf discloses the fixed time of etching in wet etching process (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the time of etching in the process cited by Chen because Wolf illustrates

that the time of etching would be determined by the type of etchant and the material being etched (pages 516-517).

As to claim 3, Chen discloses that the tetra methyl ammonium hydroxide temperature is in a range of about 5°C to 50°C, which is slightly lower than the range (60-90°C) cited by the applicant. However, Wolf discloses that the etching solution could be heated to about 75-80°C. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify temperature of the etching solution used by Chen because Wolf illustrates that the etching parameters such as temperature, time and concentration would determine etch rate (page 514-515).

As to claim 8 and 19, Chen discloses that the concentration of TMAH is in the range 1-10 wt% in a deionized water (paragraph 0031), which is in the overlapping range cited by the applicant.

As to claim 12-13 and 22-23, Chen discloses the use of TMAH in the etching solution but fails to disclose the presence of a percentage of ammonium hydroxide in the etching mixture. However, Wolf suggests the use of ammonium hydroxide for the wet etching process (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to

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combine ammonium hydroxide and TMAH in the etching solution of Chen because Wolf teaches that etchants can be combined to improve etch selectivity.

As to claim 14-16 and 24-26, Chen discloses the etching of the silicon oxide (paragraph 0043), polysilicon layer (paragraph 0045) and doped oxide layer (paragraph 0046) but is silent about the etch rate. According to Wolf, the etch rate is affected by large number of parameters such as, type of feed gas, power, and pressure in dry etching (pages 546-547) and type of etchant, temperature of etchant and surface contaminants (pages 521-523). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select etch rate in the process suggested by Chen because Wolf discloses that the etch rate influences both isotropic and anisotropic etching and control of edge profiles (pages 551-552).

As to claim 17, Chen discloses a method of etching polysilicon consisting of TMAH (paragraph 0031) but fails to disclose the presence of ammonium hydroxide in the etching solution. However, Wolf discloses the use of ammonium hydroxide in the etch solution and removing the substrate from the etch solution after a pre-selected time period (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select ammonium hydroxide in the etching solution in the process cited by Chen

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because Wolf illustrates that ammonium hydroxide removes residual organic contaminants from certain metals (page 516).

Chen is silent about the removal of the substrate from the etch solution after a pre-selected time period. However, Wolf discloses the fixed time of etching in wet etching process (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the time of etching in the process cited by Chen because Wolf illustrates that the time of etching would determine the type of etchant and the material being etched (pages 516-517).

As to *claim 18*, Chen discloses that the tetra methyl ammonium hydroxide temperature is in a range of about 5°C to 50°C, which is slightly lower than the range (60-90°C) cited by the applicant. However, Wolf discloses that the etching solution could be heated to about 75-80°C. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify temperature of the etching solution used by Chen because Wolf illustrates that the etching parameters such as temperature, time and concentration would determine etch rate (page 514-515).

Claim Rejections - 35 USC § 103

3. Claims 5 and 6 are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986) as applied to claim 1, in further view of Li (US Patent No. 5, 783,495).

As to claim 5, Chen is silent about the single wafer spinning vacuum chuck with TMAH dispensing nozzle. However, Li discloses a process chamber that includes a provision for TMAH dispensing nozzle (31) and wafer spinning vacuum chuck (10) (Fig.5) (col.7, lines 52-57, col.8, lines 18-24). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process chamber used by Chen because Li illustrates process chamber (Fig.5) with a spinning vacuum chuck would control the flow of acid, deionized water and the carrier gas at a steady rate (col.8, lines1-5).

As to claim 6, Chen is silent about the temperature of the droplets. However, Li discloses the temperature of the cleaning in the range 40°C to 100°C (col.5, lines 48-50). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the droplet temperature of the cleaning fluid in the process cited by Chen because Li illustrates that the cleaning is effective and long lasting at the temperature range 40°C to 100°C (col.5, lines 50-51).

Claim Rejections - 35 USC § 103

4. Claims 3, 7, 9 and are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press

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(1986) as applied to claim 1, in further view of Schoeppel (US Patent No. 5,039,349).

As to claim 3, Chen is silent about the temperature of the TMAH solution. However, Schoeppel discloses that the temperature of the TMAH containing solution is in the range 85-90°C which overlaps the range cited by the applicant (col.7, lines 7-9). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the temperature of the etching solution as in the case of Chen because Schoeppel illustrates that at elevated temperatures the deionized water itself is very aggressive cleaner (col.7, lines 7-10).

As to claim 7, Chen is silent about the chemical etch solution consisting of an open bath having temperature control. However, Schoeppel discloses the use of RCA type bath around 50°C (col.2, lines 26-28). In addition, it is standard laboratory practice to use a temperature controller to maintain the temperature of the bath. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select temperature bath and the temperature controller in the process used by Chen because Schoeppel illustrates that it is important to maintain bath temperature to remove organic contaminants from the wafer surface.

As to *claim 9 and 20*, Chen discloses that the concentration of TMAH is in the range 1 to about 10-wt% which is close to the range cited by the applicant. Chen is silent about the pH of the solution. However, Schoeppel discloses that the pH of the solution is in the range 11-13 (col.7, lines 10-11). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the pH of the solution in the process used by Chen because Schoeppel illustrates that the efficacy of the etching solution is dependent on the pH of the solution and it is replenished when it falls below 11. (col.7, lines 13-15).

Claim Rejections - 35 USC § 103

5. Claims 10, 11 and 21 are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986) as applied to claim 1, in further view of Hardy (US Patent No. 6,238,592).

Chen does not disclose the presence of ammonium hydroxide in the etching solution. However, Hardy discloses the presence of ammonium hydroxide as a complexing agent in the etching solution and its concentration in the range 0.01 to 50 wt% in deionized water (col.8, lines 63-65), which is in the overlapping range cited by the applicant.

Response to Arguments

6. Applicant's arguments filed on Dec 18, 2006 have been fully considered but they are not persuasive.

(a) *With respect to claim 1*, applicants' arguments on page 9 of the reply that the reference of Chen does not have photo-resist on the polysilicon layer at the time the etching is performed is not convincing.

Chen discloses the wet etch process operates by depositing a layer of silicon-containing material (such as polysilicon), masking it with a patterned resist layer (paragraph 0026). Chen further explains that the masking layer is stripped from the layer of silicon-containing material (pararagraph 0030) and the layer of silicon-containing material is etched with an etching process using tetramethyl ammonium hydroxide (TMAH) (paragraph 0031).

(b) *With respect to claims 3, 5-11 and 21*, the combined teachings of Chien, Wolf, Li, Schoepel and Hardy meet all the limitation defined in these claims (see arguments on pages 2-9 above).

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory

Art Unit: 1765

action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Itoh (US Patent No. 4,729,941) discloses photoresist processing solution with quaternary ammonium hydroxide.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maki A. Angadi whose telephone number is 571-272-8213. The examiner can normally be reached on 8 AM to 4.30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR

Art Unit: 1765

system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dr. Maki Angadi
Examiner,
Art Unit 1765

NADINE G. MORTON
SUPERVISOR, EXAMINER





PTO/SB00A(10-01)
Approved for use through 10/31/2002. OMB 051-0031
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Substitute for form 1449A/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)	Complete if Known	
	Application Number	11/168,023
	Filing Date	June 28, 2005
	First Named Inventor	Shea, Kevin
	Group Art Unit	1765
	Examiner Name	Angadi, Maki
Sheet 1 of 1		Attorney Docket No: 303.898US1



US PATENT DOCUMENTS				
Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document	Filing Date If Appropriate
	US-20010014522A1	08/16/2001	Weimer, R. A., et al.	09/15/1999
	US-20020004263A1	01/10/2002	Tanabe, Y., et al.	08/15/2001
	US-20020173150A1	11/21/2002	Kawai, K., et al.	04/09/2002
	US-20030045113A1	03/06/2003	Enomoto, H., et al.	07/19/2002
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	US-20040132272A1	07/08/2004	Ku, J., et al.	09/22/2003
	US-20040171241A1	09/02/2006	Kitamura, E., et al.	01/14/2004
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	US-20040266154A1	12/30/2004	Lim, K., et al.	12/30/2003
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	US-20050085074A1	04/21/2005	Powell, D. C.	10/17/2003
	US-20060261415A1	11/23/2006	Gonzalez, F., et al.	07/27/2006
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	US-6,048,803	04/11/2000	Gardner, M. I., et al.	08/19/1997
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	US-6,153,509	11/28/2000	Watanabe, K., et al.	06/30/1999
	US-6,288,419	09/11/2001	Prall, Kirk D., et al.	07/09/1999
	US-6,313,003	11/06/2001	Chen, H-S	08/17/2000
	US-6,417,551	07/09/2002	Miyano, K.	02/21/2001
	US-6,429,105	08/06/2002	Kunikiyo, T.	07/10/2000
	US-6,593,229	07/15/2003	Yamamoto, N., et al.	08/09/2000
	US-6,774,012	08/10/2004	Narayanan, S.	11/08/2002
MA	US-7,029,999	04/18/2006	Lim, K., et al.	12/30/2003

FOREIGN PATENT DOCUMENTS				
Examiner Initials *	Foreign Document No	Publication Date	Name of Patentee or Applicant of cited Document	T ¹

OTHER DOCUMENTS - NON PATENT LITERATURE DOCUMENTS				T ¹
Examiner Initials *	Cite No ¹	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.		

EXAMINER

/Maki Angadi/

DATE CONSIDERED

01/10/2007

Substitute Disclosure Statement Form (PTO-1449)
* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 809. Draw line through citation if not in conformance and not considered. Include a copy of this form with next communication to applicant. Applicant's unique citation designation number (optional) Applicant is to place a check mark here if English language Translation is attached



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JUN 21 2007

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/168,023	06/28/2005	Kevin Shea	303.898US1	9578

21186 7590 06/18/2007
SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
P.O. BOX 2938
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EXAMINER

ANGADI, MAKI A

ART UNIT	PAPER NUMBER
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1765

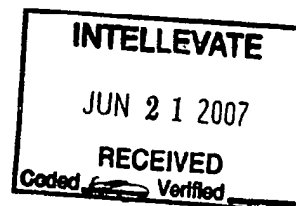
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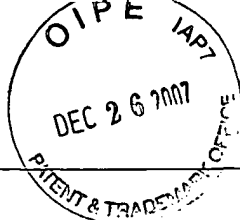
06/18/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.





Office Action Summary

Application No.

11/168,023

Applicant(s)

SHEA, KEVIN

Examiner

Maki A. Angadi

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 April 2007.
2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-40 is/are pending in the application.
4a) Of the above claim(s) 27-40 is/are withdrawn from consideration.
5) ☐ Claim(s) _____ is/are allowed.
6) ☒ Claim(s) 1-26 is/are rejected.
7) ☐ Claim(s) _____ is/are objected to.
8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>4/30/07, 6/5/07</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 4/30/2007 has been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1-3, 8, 12-19 and 22-26 are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986).

As to claim 1, Chen discloses a method of forming a patterned polysilicon layer (paragraph 0026) in a single etch solution consisting of: (a) exposing a substrate having a photo-resist pattern on a polysilicon layer (Fig.2B, paragraph 0043, Fig.2E, paragraph 0045) to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide (TMAH) and water at a pre-selected temperature and first concentration (paragraph 0031, paragraph 0045).

Chen is silent about the removal of the substrate from the etch solution after a pre-selected time period. However, Wolf discloses the fixed time of etching in wet etching process (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the time of etching in the process cited by Chen because Wolf illustrates that the time of etching would be determined by the type of etchant and the material being etched (pages 516-517).

As to claim 2, Chen is silent about the use of ammonium hydroxide in the etch solution. However, Wolf discloses the use of ammonium hydroxide in the etch solution and removing the substrate from the etch solution after a pre-selected time period (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select ammonium hydroxide in the etching solution in the process cited by Chen because Wolf illustrates that ammonium hydroxide removes residual organic contaminants from certain metals (page 516).

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that the time of etching would be determined by the type of etchant and the material being etched (pages 516-517).

As to claim 3, Chen discloses that the tetra methyl ammonium hydroxide temperature is in a range of about 5°C to 50°C, which is slightly lower than the range (60-90°C) cited by the applicant. However, Wolf discloses that the etching solution could be heated to about 75-80°C. Therefore, it would have been obvious to one of ordinary skill in the art at the time invention was made to modify temperature of the etching solution used by Chen because Wolf illustrates that the etching parameters such as temperature, time and concentration would determine etch rate (page 514-515).

As to claim 8 and 19, Chen discloses that the concentration of TMAH is in the range 1-10 wt% in de-ionized water (paragraph 0031), which is in the overlapping range cited by the applicant.

As to claim 12-13 and 22-23, Chen discloses the use of TMAH in the etching solution but fails to disclose the presence of a percentage of ammonium hydroxide in the etching mixture. However, Wolf suggests the use of ammonium hydroxide for the wet etching process (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to

combine ammonium hydroxide and TMAH in the etching solution of Chen because Wolf teaches that etchants can be combined to improve etch selectivity.

As to claim 14-16 and 24-26, Chen discloses the etching of the silicon oxide (paragraph 0043), polysilicon layer (paragraph 0045) and doped oxide layer (paragraph 0046) but is silent about the etch rate. According to Wolf, the etch rate is affected by large number of parameters such as, type of feed gas, power, and pressure in dry etching (pages 546-547) and type of etchant, temperature of etchant and surface contaminants (pages 521-523). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select etch rate in the process suggested by Chen because Wolf discloses that the etch rate influences both isotropic and anisotropic etching and control of edge profiles (pages 551-552).

As to claim 17, Chen discloses a method of etching polysilicon consisting of TMAH (paragraph 0031) but fails to disclose the presence of ammonium hydroxide in the etching solution. However, Wolf discloses the use of ammonium hydroxide in the etch solution and removing the substrate from the etch solution after a pre-selected time period (page 516). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select ammonium hydroxide in the etching solution in the process cited by Chen

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Claim Rejections - 35 USC § 103

3. Claims 5 and 6 are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986) as applied to claim 1, in further view of Li (US Patent No. 5, 783,495).

As to *claim 5*, Chen is silent about the single wafer spinning vacuum chuck with TMAH dispensing nozzle. However, Li discloses a process chamber that includes a provision for TMAH dispensing nozzle (31) and wafer spinning vacuum chuck (10) (Fig.5) (col.7, lines 52-57, col.8, lines 18-24). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process chamber used by Chen because Li illustrates process chamber (Fig.5) with a spinning vacuum chuck would control the flow of acid, deionized water and the carrier gas at a steady rate (col.8, lines1-5).

As to *claim 6*, Chen is silent about the temperature of the droplets. However, Li discloses the temperature of the cleaning in the range 40°C to 100°C (col.5, lines 48-50). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the droplet temperature of the cleaning fluid in the process cited by Chen because Li illustrates that the cleaning is effective and long lasting at the temperature range 40°C to 100°C (col.5, lines 50-51).

Claim Rejections - 35 USC § 103

4. Claims 3, 7, 9 and are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986) as applied to claim 1, in further view of Schoeppel (US Patent No. 5,039,349).

As to *claim 3*, Chen is silent about the temperature of the TMAH solution. However, Schoeppel discloses that the temperature of the TMAH containing solution is in the range 85-90°C which overlaps the range cited by the applicant (col.7, lines 7-9). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the temperature of the etching solution as in the case of Chen because Schoeppel illustrates that at elevated temperatures the deionized water itself is very aggressive cleaner (col.7, lines 7-10).

As to *claim 7*, Chen is silent about the chemical etch solution consisting of an open bath having temperature control. However, Schoeppel discloses the use of RCA type bath around 50°C (col.2, lines 26-28). In addition, it is standard laboratory practice to use a temperature controller to maintain the temperature of the bath. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select temperature bath and the temperature controller in the process used by Chen because Schoeppel illustrates that it is important to maintain bath temperature to remove organic contaminants from the wafer surface.

As to *claim 9 and 20*, Chen discloses that the concentration of TMAH is in the range 1 to about 10-wt% which is close to the range cited by the applicant. Chen is silent about the pH of the solution. However, Schoeppel discloses that

the pH of the solution is in the range 11-13 (col.7, lines 10-11). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the pH of the solution in the process used by Chen because Schoepel illustrates that the efficacy of the etching solution is dependent on the pH of the solution and it is replenished when it falls below 11 (col.7, lines 13-15).

Claim Rejections - 35 USC § 103

5. Claims 10, 11 and 21 are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986) as applied to claim 1, in further view of Hardy (US Patent No. 6,238,592).

Chen does not disclose the presence of ammonium hydroxide in the etching solution. However, Hardy discloses the presence of ammonium hydroxide as a complexing agent in the etching solution and its concentration in the range 0.01 to 50 wt% in deionized water (col.8, lines 63-65), which is in the overlapping range cited by the applicant.

Response to Arguments

6. Applicant's arguments filed on 4/30/2007 have been fully considered but they are not persuasive.

(a) *With respect to claim 1*, applicants' arguments on pages 8-9 of the reply asserting that the combined reference of Chen and Wolf do not teach the presence of photo-resist on the polysilicon layer at the time the etching is performed is not convincing.

Chen discloses the wet etch process operates by depositing a layer of silicon-containing material (such as polysilicon), masking it with a patterned resist layer (paragraph 0026). Chen further explains that the masking layer is stripped from the layer of silicon-containing material (paragraph 0030) and the layer of silicon-containing material is etched with an etching process using tetramethyl ammonium hydroxide (TMAH) (paragraph 0031). Chen illustrates the presence of photoresist layer (281) on the polysilicon layer (285) (Fig.2E) at time the time etching is performed (paragraph 0045). It is within the scope of one who is skilled in the art at the time the invention was made to select the sequence of wet etching steps in the fabrication of memory devices as is illustrated by Chen in various embodiments (paragraph 0010-0014).

(b) *With respect to claims 3, 5-11 and 21*, the combined teachings of Chien, Wolf, Li, Schoeppel and Hardy meet all the limitation defined in these claims (see arguments on pages 2-9 above).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Itoh (US Patent No. 4,729,941) discloses photoresist processing solution with quaternary ammonium hydroxide.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maki A. Angadi whose telephone number is 571-272-8213. The examiner can normally be reached on 8 AM to 4.30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dr. Maki Angadi
Examiner,
Art Unit 1765

LAN VINH
PRIMARY EXAMINER



Substitute for form 1449A/PTO
**INFORMATION DISCLOSURE
 STATEMENT BY APPLICANT**
 (Use as many sheets as necessary)



Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

<i>Complete if Known</i>	
Application Number	11/168,023
Filing Date	June 28, 2005
First Named Inventor	Shea, Kevin
Group Art Unit	1765
Examiner Name	Angadi, Maki

Sheet 1 of 1

Attorney Docket No: 303.898US1

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document	Filing Date If Appropriate
	US-20010051440	12/13/2001	Torek, Kevin J., et al.	06/29/1999
	US-5,855,811	01/05/1999	Grieger, E. K., et al.	10/03/1996
✓ /MA/	US-5,990,019	11/23/1999	Torek, Kevin, et al.	11/10/1997

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Foreign Document No	Publication Date	Name of Patentee or Applicant of cited Document	T ²
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OTHER DOCUMENTS -- NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No ¹	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T ⁴
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EXAMINER

/Maki Angadi/

DATE CONSIDERED

05/07/2007

Substitute Disclosure Statement Form (PTO-1449)
 * EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 606. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. † Applicant's unique citation designation number (optional) ‡ Applicant is to place a check mark here if English language Translation is attached

Substitute for form 1449A/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2" style="text-align: center;"><i>Complete if Known</i></td> </tr> <tr> <td style="width: 50%;">Application Number</td> <td>11/168,023</td> </tr> <tr> <td>Filing Date</td> <td>June 28, 2005</td> </tr> <tr> <td>First Named Inventor</td> <td>Shea, Kevin</td> </tr> <tr> <td>Group Art Unit</td> <td>1765</td> </tr> <tr> <td>Examiner Name</td> <td>Angadi, Maki</td> </tr> <tr> <td colspan="2" style="text-align: center;">Attorney Docket No: 303.898US1</td> </tr> </table>	<i>Complete if Known</i>		Application Number	11/168,023	Filing Date	June 28, 2005	First Named Inventor	Shea, Kevin	Group Art Unit	1765	Examiner Name	Angadi, Maki	Attorney Docket No: 303.898US1	
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Attorney Docket No: 303.898US1															
Sheet 1 of 1															

US PATENT DOCUMENTS				
Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document	Filing Date If Appropriate
/MA/	US-6,720,132	04/13/2004	Tsai, M. H., et al.	01/08/2002

EXAMINER /Maki Angadi/

DATE CONSIDERED 06/13/2007



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APPLICATION NO.	FILED DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/168,023	06/28/2005	Kevin Shea	303.898US1	9578

21186 7590 09/14/2006

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER

ANGADI, MAKI A

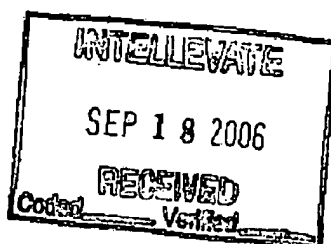
ART UNIT

PAPER NUMBER

1765

DATE MAILED: 09/14/2006

Please find below and/or attached an Office communication concerning this application or proceeding.



Schwegman, Lundberg,
Woessner & Kluth, P.A.

SEP 18 2006

RECEIVED

Office Action Summary	Application No. 11/168,023	Applicant(s) SHEA, KEVIN	
	Examiner Maki A. Angadi	Art Unit 1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 June 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) 27-40 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 28 June 2006 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
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| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>6/28/2005</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claim 1-26 drawn to method of forming patterned silicon layer classified in class 216 subclass 83.
 - II. Claims 27-32 drawn to etching polysilicon layer on IC substrate classified in class 438 subclass 689.
 - III. Claims 33-40 drawn to method of fabricating an electronic memory classified in class 257 subclass 314.
2. The inventions are distinct, each from the other because of the following reasons:

Inventions I-III and II-III are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make another and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case patterning of silicon layer could be used to make other semiconductor devices such as solar cells or sensors.
3. Because these inventions are independent or distinct for the reasons given above and have acquired a separate status in the art in view of their different classification, restriction for examination purposes as indicated is proper.

Art Unit: 1765

4. During a telephone conversation with Suneel Arora on 4/25/2006 a provisional election was made with traverse to prosecute the invention of group I claims 1-26. Affirmation of this election must be made by applicant in replying to this Office action. Claims 27-40 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Claim Rejections - 35 USC § 103

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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As to *claim 5*, Chen is silent about the single wafer spinning vacuum chuck with TMAH dispensing nozzle. However, Li discloses a process chamber

that includes a provision for TMAH dispensing nozzle (31) and wafer spinning vacuum chuck (10) (Fig.5) (col.7, lines 52-57, col.8, lines 18-24). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process chamber used by Chen because Li illustrates process chamber (Fig.5) with a spinning vacuum chuck would control the flow of acid, deionized water and the carrier gas at a steady rate (col.8, lines1-5).

As to claim 6, Chen is silent about the temperature of the droplets. However, Li discloses the temperature of the cleaning in the range 40°C to 100°C (col.5, lines 48-50). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the droplet temperature of the cleaning fluid in the process cited by Chen because Li illustrates that the cleaning is effective and long lasting at the temperature range 40°C to 100°C (col.5, lines 50-51).

Claim Rejections - 35 USC § 103

7. Claims 3, 7, 9 and are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986) as applied to claim 1, in further view of Schoeppel (US Patent No. 5,039,349).

As to *claim 3*, Chen is silent about the temperature of the TMAH solution. However, Schoeppel discloses that the temperature of the TMAH containing solution is in the range 85-90°C which overlaps the range cited by the applicant (col.7, lines 7-9). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the temperature of the etching solution as in the case of Chen because Schoeppel illustrates that at elevated temperatures the deionized water itself is very aggressive cleaner (col.7, lines 7-10).

As to *claim 7*, Chen is silent about the chemical etch solution consisting of an open bath having temperature control. However, Schoeppel discloses the use of RCA type bath around 50°C (col.2, lines 26-28). In addition, it is standard laboratory practice to use a temperature controller to maintain the temperature of the bath. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select temperature bath and the temperature controller in the process used by Chen because Schoeppel illustrates that it is important to maintain bath temperature to remove organic contaminants from the wafer surface.

As to *claim 9 and 20*, Chen discloses that the concentration of TMAH is in the range 1 to about 10 wt% which is close to the range cited by the applicant. Chen is silent about the pH of the solution. However, Schoeppel discloses that

the pH of the solution is in the range 11-13 (col.7, lines 10-11). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the pH of the solution in the process used by Chen because Schoeppel illustrates that the efficacy of the etching solution is dependent on the pH of the solution and it is replenished when it falls below 11 (col.7, lines 13-15).

Claim Rejections - 35 USC § 103

8. Claims 10, 11 and 21 are rejected under 35 U.S.C. 103(a) over Chen (US Pub.No. 2005/0104114, in view of Wolf, Silicon Processing for the VLSI Era, Lattice Press (1986) as applied to claim 1, in further view of Hardy (US Patent No. 6,238,592).

Chen does not disclose the presence of ammonium hydroxide in the etching solution. However, Hardy discloses the presence of ammonium hydroxide as a complexing agent in the etching solution and its concentration in the range 0.01 to 50 wt% in deionized water (col.8, lines 63-65), which is in the overlapping range cited by the applicant.

Conclusion

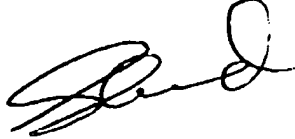
9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Itoh (US Patent No. 4,729,941) discloses photoresist processing solution with quaternary ammonium hydroxide.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maki A. Angadi whose telephone number is 571-272-8213. The examiner can normally be reached on 8 AM to 4.30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dr. Maki Angadi
Examiner
Art Unit 1765



SHAMIM AHMED
PRIMARY EXAMINER



PTO/SB/084 (10/01)
Approved for use through 10/31/2008. OMB #31-0001
US Patent & Trademark Office U.S. DEPARTMENT OF COMMERCE

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Substitute for form 1449A/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)	Complete if Known	
	Application Number	11/168,023
	Filing Date	June 28, 2005
	First Named Inventor	Shea, Kevin
	Group Art Unit	1752
	Examiner Name	Unknown
Sheet 1 of 1		Attorney Docket No: 303.898US1

US PATENT DOCUMENTS				
Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document	Filing Date If Appropriate
MA	US-20030008513	01/09/2003	Howard, Bradley J.	12/13/2001
MA	US-20030222241	12/04/2003	Torek, Kevin J., et al.	01/09/2003
MA	US-20040101784	05/27/2004	Howard, Bradley J.	11/06/2003
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MA	US-6,012,469	01/11/2000	Li, L., et al.	09/17/1997
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MA	US-6,238,592	05/29/2001	Hardy, L. C., et al.	03/10/1999
MA	US-6,245,605	08/12/2001	Hwang, Ming, et al.	08/05/1999
MA	US-6,517,738	02/11/2003	Torek, Kevin J., et al.	08/02/2000

FOREIGN PATENT DOCUMENTS				
Examiner Initials *	Foreign Document No	Publication Date	Name of Patentee or Applicant of cited Document	T ²
MA	JP-52-21457	06/10/1977	Yokoyama, Kazuo, et al.	

OTHER DOCUMENTS -- NON PATENT LITERATURE DOCUMENTS				
Examiner Initials *	Cite No ¹	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.		T ³
MA				

EXAMINER

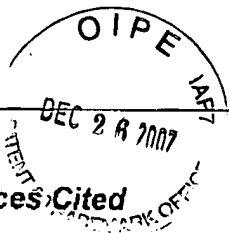
/Maki Angadi/

DATE CONSIDERED

09/05/2006

Substitute Disclosure Statement Form (PTO-1449)

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. Applicant's unique citation designation number (optional) Applicant is to place a checkmark here if English language Translation is attached



Notice of References Cited

Application/Control No.

11/168,023

Applicant(s)/Patent Under
Reexamination
SHEA, KEVIN

Examiner

Maki A. Angadi

Art Unit

1785

Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,039,349 A	08-1991	Schoeppel, John F.	134/26
*	B	US-5,783,495 A	07-1998	Li et al.	438/738
*	C	US-6,238,592 B1	05-2001	Hardy et al.	252/79.1
*	D	US-2005/0104114 A1	05-2005	Chen et al.	257/314
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

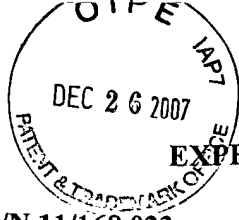
FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
1	U	S. Wolf, Silicon Processing for the VLSI Era, vol.1, Lattice Press, (1986), pages 514-517 and 551-552
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.



EXPEDITED PROCEDURE – EXAMINING GROUP 1765

S/N 11/168,023

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Kevin Shea	Examiner:	Maki A Angadi
Serial No.:	11/168,023	Group Art Unit:	1765
Filed:	June 28, 2005	Docket No.:	303.898US1
Title:	POLY ETCH WITHOUT SEPARATE OXIDE DECAP		

AMENDMENT & RESPONSE UNDER 37 C.F.R. 1.116

Mail Stop AF
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In response to the Final Office Action mailed January 25, 2007, please amend the application as follows:

IN THE CLAIMS

Please consider the claims as follows:

1. (Original) A method of forming a patterned polysilicon layer in a single chemical etch solution, comprising:

exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration; and

removing the substrate from the etch solution after a preselected time period.

2. (Original) The method of claim 1, further comprising:

adding a fixed percentage of an ammonium hydroxide solution to the etch solution, the ammonium hydroxide solution having a second concentration; and

removing the substrate from the etch solution after a preselected time period.

3. (Original) The method of claim 1, wherein the tetra methyl ammonium hydroxide temperature is in a range of approximately 60°C to 90°C.

4. (Original) The method of claim 3, wherein the temperature of the substrate is approximately 70°C.

5. (Original) The method of claim 1, wherein the chemical etch solution comprises a single wafer spinning vacuum chuck with at least a tetra methyl ammonium hydroxide dispensing nozzle.

6. (Original) The method of claim 5, wherein the dispensing nozzle provides a spray of liquid droplets, each having a temperature between 65°C and 75°C.

7. (Original) The method of claim 1, wherein the chemical etch solution comprises an open bath having a temperature control and heater device disposed to maintain the open bath in a temperature range of approximately 65°C to 75°C.
8. (Original) The method of claim 1, wherein the tetra methyl ammonium hydroxide first concentration is between 2.5% and 25% in water.
9. (Original) The method of claim 8, wherein the tetra methyl ammonium hydroxide first concentration is 12.5% and the pH of the solution is greater than 13.
10. (Original) The method of claim 1, wherein the ammonium hydroxide second concentration is between 25% and 45% in water.
11. (Original) The method of claim 10, wherein the ammonium hydroxide second concentration is approximately 35% in water.
12. (Original) The method of claim 1, wherein the fixed percentage of ammonium hydroxide solution is less than 1% of the volume of the tetra methyl ammonium hydroxide solution.
13. (Original) The method of claim 12, wherein the fixed percentage of ammonium hydroxide solution is approximately 0.2% of the volume of the tetra methyl ammonium hydroxide solution.
14. (Original) The method of claim 12, wherein an etch rate of a native silicon oxide layer on a top surface of the polysilicon layer is greater than 800 Angstroms per minute.
15. (Original) The method of claim 12, wherein an etch rate of the polysilicon layer is approximately 4000 Angstroms per minute.
16. (Original) The method of claim 15, wherein an etch rate of a doped oxide layer underneath the polysilicon layer is less than 20 Angstroms per minute.

-
17. (Previously Presented) A method of etching polysilicon, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution;
 - immersing at least one surface of a polysilicon layer having a patterned photo-resist mask in the ammonium hydroxide and tetra methyl ammonium hydroxide solution, the solution having a preselected temperature; and
 - removing the polysilicon layer after a preselected time period.
18. (Original) The method of claim 17, wherein the preselected temperature is approximately 70°C.
19. (Original) The method of claim 17, wherein the tetra methyl ammonium hydroxide solution has a concentration between 7.5% and 15% in water.
20. (Original) The method of claim 19, wherein the tetra methyl ammonium hydroxide concentration is approximately 12.5% and the pH of the solution is greater than 13.
21. (Original) The method of claim 17, wherein the ammonium hydroxide concentration is approximately 35% in water.
22. (Original) The method of claim 17, wherein the first volume of ammonium hydroxide solution is less than 1% of the second volume of the tetra methyl ammonium hydroxide solution.
23. (Original) The method of claim 22, wherein the first volume of ammonium hydroxide solution is greater than 0.2% of the volume of the tetra methyl ammonium hydroxide solution.
24. (Original) The method of claim 22, wherein an etch rate of a native silicon oxide layer on the surface of the polysilicon layer is greater than 800 Angstroms per minute.

-
25. (Original) The method of claim 22, wherein an etch rate of the polysilicon layer is approximately 4000 Angstroms per minute.
26. (Original) The method of claim 25, wherein an etch rate of a doped oxide layer disposed beneath the polysilicon layer is less than 20 Angstroms per minute.
27. (Withdrawn) A method of etching a polysilicon layer on an integrated circuit substrate, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution at a first time;
 - immersing the substrate in the ammonium hydroxide and tetra methyl ammonium hydroxide solution within one hour of the first time;
 - removing the substrate after expiration of a preselected time period;
 - removing essentially all of the ammonium hydroxide and tetra methyl ammonium hydroxide solution from the substrate; and
 - drying the substrate.
28. (Withdrawn) The method of claim 27, wherein the first volume is less than 2% of the second volume.
29. (Withdrawn) The method of claim 27, wherein a plurality of substrates may be sequentially immersed in the ammonium hydroxide and tetra methyl ammonium hydroxide solution during a one hour time period following the first time.
30. (Withdrawn) The method of claim 29, wherein another first volume of the ammonium hydroxide solution is added to the ammonium hydroxide and tetra methyl ammonium hydroxide solution before a one of the plurality of substrates is immersed in the ammonium hydroxide and tetra methyl ammonium hydroxide solution at a point in time that is more than one hour after the first time.

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31. (Withdrawn) The method of claim 27, wherein the tetra methyl ammonium hydroxide solution has a temperature of approximately 70°C.
32. (Withdrawn) The method of claim 27, wherein the tetra methyl ammonium hydroxide solution has a concentration of approximately 12.5%, and the pH of the solution is greater than 13.
33. (Withdrawn) A method of fabricating an electronic memory, comprising:
- forming a substrate including an array of active electronic devices;
 - forming at least one polysilicon layer on the substrate having a patterned photoresist layer on the at least one polysilicon layer; and
 - patterning the polysilicon layer in a single step etch solution, comprising exposing the substrate having the patterned photoresist layer on the polysilicon layer for a predetermined time period to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration, and at least a fixed percentage of an ammonium hydroxide solution.
34. (Withdrawn) The method of claim 33, further comprising adding the ammonium hydroxide solution to the tetra methyl ammonium hydroxide and water solution after the preselected temperature is obtained, and before the substrate is exposed to the solution.
35. (Withdrawn) The method of claim 34, wherein the tetra methyl ammonium hydroxide solution has a temperature of between 60°C to 80°C, and the fixed percentage of ammonium hydroxide is greater than 1% of the volume of the tetra methyl ammonium hydroxide and water solution.
36. (Withdrawn) The method of claim 34, wherein the tetra methyl ammonium hydroxide solution has a concentration between 10% to 15% in deionized water, the ammonium hydroxide solution has a concentration between 25% to 40% in deionized water, and the pH of the solution is greater than 13.

-
37. (Withdrawn) A method of etching an oxide cap layer on a polysilicon layer, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution at a first time period;
 - immersing the polysilicon layer in the ammonium hydroxide and tetra methyl ammonium hydroxide solution within one hour of the first time period;
 - removing the polysilicon layer from the ammonium hydroxide and tetra methyl ammonium hydroxide solution after a first preselected time period to etch the oxide cap layer and a portion of the polysilicon layer;
 - washing the polysilicon layer to remove essentially all of the ammonium hydroxide and tetra methyl ammonium hydroxide solution from the substrate; and
 - drying the substrate.
38. (Withdrawn) The method of claim 37, wherein the first volume is less than 2% of the second volume.
39. (Withdrawn) The method of claim 37, wherein the polysilicon layer is removed from the ammonium hydroxide and tetra methyl ammonium hydroxide solution after a second preselected time period greater than the first preselected time period to etch the oxide cap layer and substantially the entire polysilicon layer.
40. (Withdrawn) The method of claim 37, wherein the tetra methyl ammonium hydroxide solution has a temperature of between 60°C to 80°C, the tetra methyl ammonium hydroxide solution has a concentration between 10% to 15% in deionized water, the ammonium hydroxide solution has a concentration between 25% to 40% in deionized water, and the pH of the solution is greater than 13.

REMARKS

This paper responds to the Office Action mailed on January 25, 2007.

No claims are amended, no claims are canceled, and no claims are added; as a result, claims 1-26 are now pending in this application, with claims 27-40 standing withdrawn.

§103 Rejection of the Claims

Claims 1-3, 8, 12-19 and 22-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen (U.S. Publication 2005/0104114) in view of Wolf “Silicon Processing for the VLSI Era”, Lattice Press (1986). Applicant respectfully traverses this rejection.

Chen discloses forming a photo mask pattern (see para [0027]) and ion implanting portions of a polysilicon layer exposed by the photo mask at an angle to implant under the photo mask (see para [0028]). This is done to reduce the photo dimension below that obtainable with the photo mask itself. Chen then removes the photo mask pattern (see para [0026 and 0030] and the last two clauses of claim 1), and the unmasked bare polysilicon layer is selectively wet etched to remove the non-implanted regions. The non implanted region etches “at least two times faster” than the ion implanted region (see para [0032]). The reference teaches the removal of the photo mask prior to the etch in order to “reduce the dimensions of the selected pattern form the dimensions of the masking layer” (see para [0028]) and thus the photo mask layer (i.e., the photo resist 281 for figure 2E and para [0045]) must be removed prior to etching in order for the taught method to properly operate. Applicant respectfully disagrees with the statement on Page 10, paragraph number 6 that “applicants’ arguments on page 9 or the reply that the reference of Chen does not have photo-resist on the polysilicon layer at the time the etching is performed is not convincing”. Applicant respectfully submits that not removing the photo resist 281 prior to the etch process in Chen would result in an inoperative process, and failing of the intended purpose of the arrangement. Chen is seen as clearly teaching away from etching the polysilicon before removal of the photo mask, and thus Chen does not have, teach or suggest a layer of photo resist on the polysilicon layer at the time etching is performed. Among other reasons, Chen would not be able to obtain the reduced dimensions if the photo mask remained on the device during the etching process.

The cited Wolf reference is used in the outstanding Office Action to show that it is known to remove wafers from an etch solution after a preselected time period, and the use of ammonium hydroxide as an etchant solution. Applicant respectfully submits that the addition of Wolf does nothing to cure the above noted failure of Chen to describe or suggest each of the claimed features of the present arrangement.

Specifically, Applicant respectfully submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration ...*”, as recited in independent claim 1. As discussed above, Chen does not suggest exposing the substrate to a liquid chemical etch solution while the photo resist pattern is on the wafer, but rather uses the photo resist 281 to control an implantation process.

Applicant respectfully submits that the suggested combination of references neither describes nor suggests at least the feature of “...*immersing at least one surface of a polysilicon layer having a patterned photo-resist mask in the ammonium hydroxide and tetra methyl ammonium hydroxide solution, the solution having a preselected temperature; and removing the polysilicon layer after a preselected time period...*”, as recited in independent claim 17. The disclosed method of Chen does not have photo-resist on the polysilicon layer at the time the etching is performed. Then the suggested combination of references, whether taken alone or in any combination, does not disclose or suggest at least this claimed feature.

The dependent claims are seen as being in patentable condition at least as depending from base claims shown above to be patentable over the suggested combination of references. In view of the above, Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 5 and 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf, as applied to claim 1, and further in view of Li (U.S. 5,783,495). Applicant respectfully traverses this rejection.

The cited Chen and Wolf references have features discussed above. The cited reference of Li is used in the outstanding Office Action to show that it is known to use a dispersing nozzle to dispense TMAH.

Applicant respectfully submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution* ...”, as recited in independent claim 1, from which claims 5 and 6 depend. Applicant respectfully submits that the addition of the Wolf and Li references does not cure the failure of Chen to disclose or suggest etching the photo-resist on the polysilicon to the chemical etchant. Chen is seen as removing the photo resist to obtain smaller dimensions than may be obtained in the photo mask itself and thus there can be no motivation to combine irreconcilably different references.

The dependent claims are thus believed to be in patentable condition as depending from a patentable base claim. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 3, 7 and 9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf, as applied to claim 1, and further in view of Schoepel (U.S. 5,039,349). Applicant respectfully traverses this rejection.

The Chen and Wolf references have been discussed above with reference to the previous rejections. Schoepel is used in the outstanding Office Action to show that it is known to have the TMAH solution in the range of 85-90 deg C.

Applicant submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution* ...”, as recited in independent claim 1, from which dependent claims 3, 7 and 9 depend. Since the suggested combination of references do not describe or suggest each and every one of the claimed features, then the suggested combination of references, even if there were motivation to make the suggested combination, still does not result in the claimed arrangement.

The dependent claims are held to be in patentable condition at least as depending from a base claim shown above to be patentable over the suggested combination of references.

Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 10, 11 and 21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf, as applied to claim 1, and further in view of Hardy (U.S. 6,238,592).

Applicant respectfully traverses this rejection.

The cited Chen and Wolf references have features discussed previously. Hardy is used in the outstanding Office Action to show that the use of ammonium hydroxide and a complexing agent in the etching solution with a concentration in the range 0.01 to 50wt% in deionized water, is known in the art.

Applicant submits that the addition of Hardy does nothing to cure the above noted failure of the other references to either describe nor suggest the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution* ...”, as recited in independent claim 1, with similar language found in claim 17. The combination of references taken together suggests a method of selective etching ion implanted regions without a photo resist mask. Since the suggested combination suggests etching without photo resist to improve fine line control, then the present independent claims have features not suggested by the combination of references.

Dependent claims 10, 11 and 21 depend upon base claims 1 and 17, which have been shown above to patentable over the suggested combination of references. In view of the above, the dependent claims are also held to be in patentable condition. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Reservation of Rights

In the interest of clarity and brevity, Applicant may not have addressed every assertion made in the Office Action. Applicant’s silence regarding any such assertion does not constitute any admission or acquiescence. Applicant reserves all rights not exercised in connection with this response, such as the right to challenge or rebut any tacit or explicit characterization of any reference or of any of the present claims, the right to challenge or rebut any asserted factual or legal basis of any of the rejections, the right to swear behind any cited reference such as provided under 37 C.F.R. § 1.131 or otherwise, or the right to assert co-ownership of any cited reference. Applicant does not admit that any of the cited references or any other references of record are relevant to the present claims, or that they constitute prior art. To the extent that any rejection or

assertion is based upon the Examiner's personal knowledge, rather than any objective evidence of record as manifested by a cited prior art reference, Applicant timely objects to such reliance on Official Notice, and reserves all rights to request that the Examiner provide a reference or affidavit in support of such assertion, as required by MPEP § 2144.03. Applicant reserves all rights to pursue any cancelled claims in a subsequent patent application claiming the benefit of priority of the present patent application, and to request rejoinder of any withdrawn claim, as required by MPEP § 821.04.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney David Suhl at (508) 865-8211, or the undersigned attorney at (612) 349-9587 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

KEVIN SHEA

By his Representatives,

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.

P.O. Box 2938

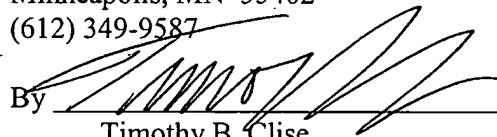
Minneapolis, MN 55402

(612) 349-9587

Date

5 March '07

By



Timothy B. Clise

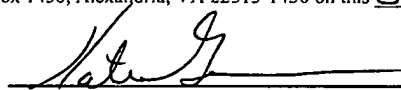
Reg. No. 40,957

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being filed using the USPTO's electronic filing system EFS-Web, and is addressed to: Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 5 day of March 2007.

Name

KEVIN SHEA

Signature





EXPEDITED PROCEDURE – EXAMINING GROUP 1765

S/N 11/168,023

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Kevin Shea	Examiner:	Maki A Angadi
Serial No.:	11/168,023	Group Art Unit:	1765
Filed:	June 28, 2005	Docket No.:	303.898US1
Title:	POLY ETCH WITHOUT SEPARATE OXIDE DECAP		

AMENDMENT & RESPONSE UNDER 37 C.F.R. 1.116

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In response to the Advisory Action mailed March 30, 2007 and the Final Office Action mailed January 25, 2007, please amend the application as follows:

IN THE CLAIMS

Please consider the claims as follows:

1. (Original) A method of forming a patterned polysilicon layer in a single chemical etch solution, comprising:

 exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration; and

 removing the substrate from the etch solution after a preselected time period.

2. (Original) The method of claim 1, further comprising:

 adding a fixed percentage of an ammonium hydroxide solution to the etch solution, the ammonium hydroxide solution having a second concentration; and

 removing the substrate from the etch solution after a preselected time period.

3. (Original) The method of claim 1, wherein the tetra methyl ammonium hydroxide temperature is in a range of approximately 60°C to 90°C.

4. (Original) The method of claim 3, wherein the temperature of the substrate is approximately 70°C.

5. (Original) The method of claim 1, wherein the chemical etch solution comprises a single wafer spinning vacuum chuck with at least a tetra methyl ammonium hydroxide dispensing nozzle.

6. (Original) The method of claim 5, wherein the dispensing nozzle provides a spray of liquid droplets, each having a temperature between 65°C and 75°C.

7. (Original) The method of claim 1, wherein the chemical etch solution comprises an open bath having a temperature control and heater device disposed to maintain the open bath in a temperature range of approximately 65°C to 75°C.
8. (Original) The method of claim 1, wherein the tetra methyl ammonium hydroxide first concentration is between 2.5% and 25% in water.
9. (Original) The method of claim 8, wherein the tetra methyl ammonium hydroxide first concentration is 12.5% and the pH of the solution is greater than 13.
10. (Original) The method of claim 1, wherein the ammonium hydroxide second concentration is between 25% and 45% in water.
11. (Original) The method of claim 10, wherein the ammonium hydroxide second concentration is approximately 35% in water.
12. (Original) The method of claim 1, wherein the fixed percentage of ammonium hydroxide solution is less than 1% of the volume of the tetra methyl ammonium hydroxide solution.
13. (Original) The method of claim 12, wherein the fixed percentage of ammonium hydroxide solution is approximately 0.2% of the volume of the tetra methyl ammonium hydroxide solution.
14. (Original) The method of claim 12, wherein an etch rate of a native silicon oxide layer on a top surface of the polysilicon layer is greater than 800 Angstroms per minute.
15. (Original) The method of claim 12, wherein an etch rate of the polysilicon layer is approximately 4000 Angstroms per minute.
16. (Original) The method of claim 15, wherein an etch rate of a doped oxide layer underneath the polysilicon layer is less than 20 Angstroms per minute.

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17. (Previously Presented) A method of etching polysilicon, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution;
 - immersing at least one surface of a polysilicon layer having a patterned photo-resist mask in the ammonium hydroxide and tetra methyl ammonium hydroxide solution, the solution having a preselected temperature; and
 - removing the polysilicon layer after a preselected time period.
18. (Original) The method of claim 17, wherein the preselected temperature is approximately 70°C.
19. (Original) The method of claim 17, wherein the tetra methyl ammonium hydroxide solution has a concentration between 7.5% and 15% in water.
20. (Original) The method of claim 19, wherein the tetra methyl ammonium hydroxide concentration is approximately 12.5% and the pH of the solution is greater than 13.
21. (Original) The method of claim 17, wherein the ammonium hydroxide concentration is approximately 35% in water.
22. (Original) The method of claim 17, wherein the first volume of ammonium hydroxide solution is less than 1% of the second volume of the tetra methyl ammonium hydroxide solution.
23. (Original) The method of claim 22, wherein the first volume of ammonium hydroxide solution is greater than 0.2% of the volume of the tetra methyl ammonium hydroxide solution.
24. (Original) The method of claim 22, wherein an etch rate of a native silicon oxide layer on the surface of the polysilicon layer is greater than 800 Angstroms per minute.

25. (Original) The method of claim 22, wherein an etch rate of the polysilicon layer is approximately 4000 Angstroms per minute.
26. (Original) The method of claim 25, wherein an etch rate of a doped oxide layer disposed beneath the polysilicon layer is less than 20 Angstroms per minute.
27. (Withdrawn) A method of etching a polysilicon layer on an integrated circuit substrate, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution at a first time;
 - immersing the substrate in the ammonium hydroxide and tetra methyl ammonium hydroxide solution within one hour of the first time;
 - removing the substrate after expiration of a preselected time period;
 - removing essentially all of the ammonium hydroxide and tetra methyl ammonium hydroxide solution from the substrate; and
 - drying the substrate.
28. (Withdrawn) The method of claim 27, wherein the first volume is less than 2% of the second volume.
29. (Withdrawn) The method of claim 27, wherein a plurality of substrates may be sequentially immersed in the ammonium hydroxide and tetra methyl ammonium hydroxide solution during a one hour time period following the first time.
30. (Withdrawn) The method of claim 29, wherein another first volume of the ammonium hydroxide solution is added to the ammonium hydroxide and tetra methyl ammonium hydroxide solution before a one of the plurality of substrates is immersed in the ammonium hydroxide and tetra methyl ammonium hydroxide solution at a point in time that is more than one hour after the first time.

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31. (Withdrawn) The method of claim 27, wherein the tetra methyl ammonium hydroxide solution has a temperature of approximately 70°C.
32. (Withdrawn) The method of claim 27, wherein the tetra methyl ammonium hydroxide solution has a concentration of approximately 12.5%, and the pH of the solution is greater than 13.
33. (Withdrawn) A method of fabricating an electronic memory, comprising:
 forming a substrate including an array of active electronic devices;
 forming at least one polysilicon layer on the substrate having a patterned photoresist layer on the at least one polysilicon layer; and
 patterning the polysilicon layer in a single step etch solution, comprising exposing the substrate having the patterned photoresist layer on the polysilicon layer for a predetermined time period to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration, and at least a fixed percentage of an ammonium hydroxide solution.
34. (Withdrawn) The method of claim 33, further comprising adding the ammonium hydroxide solution to the tetra methyl ammonium hydroxide and water solution after the preselected temperature is obtained, and before the substrate is exposed to the solution.
35. (Withdrawn) The method of claim 34, wherein the tetra methyl ammonium hydroxide solution has a temperature of between 60°C to 80°C, and the fixed percentage of ammonium hydroxide is greater than 1% of the volume of the tetra methyl ammonium hydroxide and water solution.
36. (Withdrawn) The method of claim 34, wherein the tetra methyl ammonium hydroxide solution has a concentration between 10% to 15% in deionized water, the ammonium hydroxide solution has a concentration between 25% to 40% in deionized water, and the pH of the solution is greater than 13.

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37. (Withdrawn) A method of etching an oxide cap layer on a polysilicon layer, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution at a first time period;
 - immersing the polysilicon layer in the ammonium hydroxide and tetra methyl ammonium hydroxide solution within one hour of the first time period;
 - removing the polysilicon layer from the ammonium hydroxide and tetra methyl ammonium hydroxide solution after a first preselected time period to etch the oxide cap layer and a portion of the polysilicon layer;
 - washing the polysilicon layer to remove essentially all of the ammonium hydroxide and tetra methyl ammonium hydroxide solution from the substrate; and
 - drying the substrate.
38. (Withdrawn) The method of claim 37, wherein the first volume is less than 2% of the second volume.
39. (Withdrawn) The method of claim 37, wherein the polysilicon layer is removed from the ammonium hydroxide and tetra methyl ammonium hydroxide solution after a second preselected time period greater than the first preselected time period to etch the oxide cap layer and substantially the entire polysilicon layer.
40. (Withdrawn) The method of claim 37, wherein the tetra methyl ammonium hydroxide solution has a temperature of between 60°C to 80°C, the tetra methyl ammonium hydroxide solution has a concentration between 10% to 15% in deionized water, the ammonium hydroxide solution has a concentration between 25% to 40% in deionized water, and the pH of the solution is greater than 13.

REMARKS

This paper responds to the Advisory Action mailed on March 30, 2007.

No claims are amended, no claims are canceled, and no claims are added; as a result, claims 1-40 are now pending in this application, with claims 27-40 standing withdrawn.

The Advisory Action did not indicate whether the response filed March 5, 2007 was entered, and Applicant has repeated the body of the response below. The Advisory Action states in the continuation of paragraph 11 that “Chen discloses the wet etch process operated by depositing a layer of silicon-containing material (such as polysilicon), masking it with a patterned resist layer (paragraph 0026)”. Applicant respectfully disagrees with the Examiner’s statement since Chen performs the wet etch process after the photoresist is removed. The paragraph of the Chen cited by the Examiner (paragraph 0026) clearly states that “the wet etch process operates by depositing a layer of silicon-containing material (such as polysilicon), masking it with a patterned resist layer, and then implanting the exposed areas of the silicon-containing material with ions to a selected threshold dosage level”, which Applicant submits clearly shows that the patterned resist layer discussed by the Examiner is an implantation mask. The cited section of Chen continues in the next sentence, saying “After implanting the ions, the resist layer is stripped and the silicon-containing material is then wet etched to remove the excess material”, which clearly shows that the wet etch process operates without the presence of the resist layer, which has been stripped off previous to the etch, as discussed by Applicant in the previous responses.

Applicant thus respectfully submits that the cited Chen reference clearly teaches away from etching the polysilicon before removal of the photo mask. Chen does not disclose or suggest a layer of photo resist on the polysilicon layer at the time etching is performed. Chen would violate the intent of the disclosure, and not be able to obtain the intended reduced dimension after etch if the photo mask remained on the device during the etching process. That this is so may be clearly seen in Chen in the same portion of the application cited by the Examiner (paragraph 0026) which clearly states that “The etch rate of the implanted regions of the silicon-containing material during wet etch will be lower than the un-implanted regions”, which shows that the area to be removed is the area that was underneath the photo-resist layer, as

compared to the present application which etches the material that is exposed by the patterned photo-resist. The intent of Chen in using an etch that occurs after the resist mask is removed is clearly explained in paragraph 0028, where it states that the intent is “to reduce the dimensions of the selected pattern from the dimensions of the masking layer” and to have “an effect in sculpting the resulting shaped structure”. Applicant respectfully submits that the above two specific sections of the cited Chen reference make clear that the Examiner has misinterpreted paragraph 0026 which was cited in the Advisory Action.

Applicant further respectfully disagrees with the statement in the Advisory Action that “Chen further explains that the masking layer is stripped from the layer of silicon-containing material (paragraph 0030) and the layer of silicon-containing material is etched with an etching process using tetramethyl ammonium hydroxide (TMAH)(paragraph 0031)”, asserting that the with “respect to claim 1, applicant’s arguments .. that the reference of Chen does not have photo-resist on the polysilicon layer at the time the etching is performed is not convincing”. Applicant submits that Chen states in paragraph 0030 that the “masking layer in a subsequent procedure is stripped from the layer of silicon-containing material, and the layer of silicon-containing material is then etched with an etching process”, which once again clearly shows that the resist in Chen is not in place during the etch process, as compared to the present application.

Applicant respectfully submits that the above evidence shows that at least the cited reference of Chen does not describe nor suggest the claim feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration ...*”, as recited in independent claim 1. At least in the two sections of the reference cited by the Examiner a close examination of the reference clearly shows that the resist is removed prior to the liquid chemical etch solution, and that thus the reference fails to suggest the feature that the Examiner uses in the Advisory Action. Applicant respectfully submits that Chen teaches away from the claimed arrangement by disclosing etching after the resist is removed “to reduce the dimensions of the selected pattern from the dimensions of the masking layer” as found in Chen’s paragraph 0028. Thus, Chen does not suggest etching with the resist pattern in place, and suggests etching away the portion of the layer that had been underneath the resist layer. Applicant respectfully requests that the Chen reference be withdrawn.

§103 Rejection of the Claims

Claims 1-3, 8, 12-19 and 22-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen (U.S. Publication 2005/0104114) in view of Wolf “Silicon Processing for the VLSI Era”, Lattice Press (1986). Applicant respectfully traverses this rejection.

Chen discloses forming a photo mask pattern (see para [0027]) and ion implanting portions of a polysilicon layer exposed by the photo mask at an angle to implant under the photo mask (see para [0028]). This is done to reduce the photo dimension below that obtainable with the photo mask itself. Chen then removes the photo mask pattern (see para [0026 and 0030] and the last two clauses of claim 1), and the unmasked bare polysilicon layer is selectively wet etched to remove the non-implanted regions. The non implanted region etches “at least two times faster” than the ion implanted region (see para [0032]). The reference teaches the removal of the photo mask prior to the etch in order to “reduce the dimensions of the selected pattern form the dimensions of the masking layer” (see para [0028]) and thus the photo mask layer (i.e., the photo resist 281 for figure 2E and para [0045]) must be removed prior to etching in order for the taught method to properly operate. Applicant respectfully disagrees with the statement on Page 10, paragraph number 6 that “applicants’ arguments on page 9 or the reply that the reference of Chen does not have photo-resist on the polysilicon layer at the time the etching is performed is not convincing”. Applicant respectfully submits that not removing the photo resist 281 prior to the etch process in Chen would result in an inoperative process, and failing of the intended purpose of the arrangement. Chen is seen as clearly teaching away from etching the polysilicon before removal of the photo mask, and thus Chen does not have, teach or suggest a layer of photo resist on the polysilicon layer at the time etching is performed. Among other reasons, Chen would not be able to obtain the reduced dimensions if the photo mask remained on the device during the etching process.

The cited Wolf reference is used in the outstanding Office Action to show that it is known to remove wafers from an etch solution after a preselected time period, and the use of ammonium hydroxide as an etchant solution. Applicant respectfully submits that the addition of Wolf does nothing to cure the above noted failure of Chen to describe or suggest each of the claimed features of the present arrangement.

Specifically, Applicant respectfully submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration ...*”, as recited in independent claim 1. As discussed above, Chen does not suggest exposing the substrate to a liquid chemical etch solution while the photo resist pattern is on the wafer, but rather uses the photo resist 281 to control an implantation process.

Applicant respectfully submits that the suggested combination of references neither describes nor suggests at least the feature of “...*immersing at least one surface of a polysilicon layer having a patterned photo-resist mask in the ammonium hydroxide and tetra methyl ammonium hydroxide solution, the solution having a preselected temperature; and removing the polysilicon layer after a preselected time period...*”, as recited in independent claim 17. The disclosed method of Chen does not have photo-resist on the polysilicon layer at the time the etching is performed. Then the suggested combination of references, whether taken alone or in any combination, does not disclose or suggest at least this claimed feature.

The dependent claims are seen as being in patentable condition at least as depending from base claims shown above to be patentable over the suggested combination of references. In view of the above, Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 5 and 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf, as applied to claim 1, and further in view of Li (U.S. 5,783,495). Applicant respectfully traverses this rejection.

The cited Chen and Wolf references have features discussed above. The cited reference of Li is used in the outstanding Office Action to show that it is known to use a dispersing nozzle to dispense TMAH.

Applicant respectfully submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution ...*”, as recited in independent claim 1, from which claims 5 and 6 depend. Applicant respectfully submits that the addition of the Wolf and Li references does not cure the failure of Chen to disclose or suggest etching the

photo-resist on the polysilicon to the chemical etchant. Chen is seen as removing the photo resist to obtain smaller dimensions than may be obtained in the photo mask itself and thus there can be no motivation to combine irreconcilably different references.

The dependent claims are thus believed to be in patentable condition as depending from a patentable base claim. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 3, 7 and 9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf, as applied to claim 1, and further in view of Schoepel (U.S. 5,039,349). Applicant respectfully traverses this rejection.

The Chen and Wolf references have been discussed above with reference to the previous rejections. Schoepel is used in the outstanding Office Action to show that it is known to have the TMAH solution in the range of 85-90 deg C.

Applicant submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution* ...”, as recited in independent claim 1, from which dependent claims 3, 7 and 9 depend. Since the suggested combination of references do not describe or suggest each and every one of the claimed features, then the suggested combination of references, even if there were motivation to make the suggested combination, still does not result in the claimed arrangement.

The dependent claims are held to be in patentable condition at least as depending from a base claim shown above to be patentable over the suggested combination of references. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 10, 11 and 21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf, as applied to claim 1, and further in view of Hardy (U.S. 6,238,592). Applicant respectfully traverses this rejection.

The cited Chen and Wolf references have features discussed previously. Hardy is used in the outstanding Office Action to show that the use of ammonium hydroxide and a complexing agent in the etching solution with a concentration in the range 0.01 to 50wt% in deionized water, is known in the art.

Applicant submits that the addition of Hardy does nothing to cure the above noted failure of the other references to either describe nor suggest the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution* ...”, as recited in independent claim 1, with similar language found in claim 17. The combination of references taken together suggests a method of selective etching ion implanted regions without a photo resist mask. Since the suggested combination suggests etching without photo resist to improve fine line control, then the present independent claims have features not suggested by the combination of references.

Dependent claims 10, 11 and 21 depend upon base claims 1 and 17, which have been shown above to patentable over the suggested combination of references. In view of the above, the dependent claims are also held to be in patentable condition. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Reservation of Rights

In the interest of clarity and brevity, Applicant may not have addressed every assertion made in the Office Action. Applicant’s silence regarding any such assertion does not constitute any admission or acquiescence. Applicant reserves all rights not exercised in connection with this response, such as the right to challenge or rebut any tacit or explicit characterization of any reference or of any of the present claims, the right to challenge or rebut any asserted factual or legal basis of any of the rejections, the right to swear behind any cited reference such as provided under 37 C.F.R. § 1.131 or otherwise, or the right to assert co-ownership of any cited reference. Applicant does not admit that any of the cited references or any other references of record are relevant to the present claims, or that they constitute prior art. To the extent that any rejection or assertion is based upon the Examiner’s personal knowledge, rather than any objective evidence of record as manifested by a cited prior art reference, Applicant timely objects to such reliance on Official Notice, and reserves all rights to request that the Examiner provide a reference or

affidavit in support of such assertion, as required by MPEP § 2144.03. Applicant reserves all rights to pursue any cancelled claims in a subsequent patent application claiming the benefit of priority of the present patent application, and to request rejoinder of any withdrawn claim, as required by MPEP § 821.04.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney David Suhl at (508) 865-8211, or the undersigned attorney at (612) 349-9587 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

KEVIN SHEA

By his Representatives,

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.

P.O. Box 2938

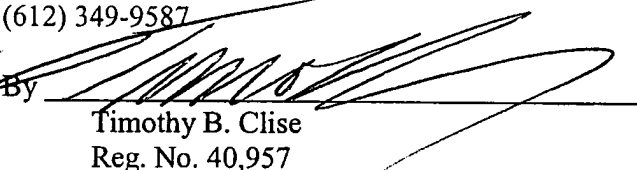
Minneapolis, MN 55402

(612) 349-9587

Date

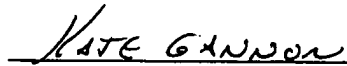
25 April '07

By


Timothy B. Clise
Reg. No. 40,957

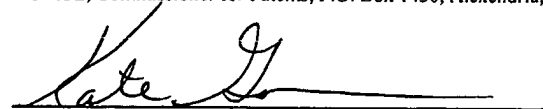
CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: MS RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 25 day of April 2007.

Name



Kate Gannon

Signature



Kate Gannon



S/N 11/168,023

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Kevin Shea

Examiner: Maki A Angadi

Serial No.: 11/168,023

Group Art Unit: 1765

Filed: June 28, 2005

Docket No.: 303.898US1

Title: POLY ETCH WITHOUT SEPARATE OXIDE DECAP

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.111

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

This paper responds to the Office Action mailed on June 18, 2007. Please amend the above-identified patent application as follows.

IN THE CLAIMS

Please amend the claims as follows:

1. (Original) A method of forming a patterned polysilicon layer in a single chemical etch solution, comprising:
 - exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration; and
 - removing the substrate from the etch solution after a preselected time period.
2. (Original) The method of claim 1, further comprising:
 - adding a fixed percentage of an ammonium hydroxide solution to the etch solution, the ammonium hydroxide solution having a second concentration; and
 - removing the substrate from the etch solution after a preselected time period.
3. (Original) The method of claim 1, wherein the tetra methyl ammonium hydroxide temperature is in a range of approximately 60°C to 90°C.
4. (Original) The method of claim 3, wherein the temperature of the substrate is approximately 70°C.
5. (Original) The method of claim 1, wherein the chemical etch solution comprises a single wafer spinning vacuum chuck with at least a tetra methyl ammonium hydroxide dispensing nozzle.
6. (Original) The method of claim 5, wherein the dispensing nozzle provides a spray of liquid droplets, each having a temperature between 65°C and 75°C.

7. (Original) The method of claim 1, wherein the chemical etch solution comprises an open bath having a temperature control and heater device disposed to maintain the open bath in a temperature range of approximately 65°C to 75°C.

8. (Original) The method of claim 1, wherein the tetra methyl ammonium hydroxide first concentration is between 2.5% and 25% in water.

9. (Original) The method of claim 8, wherein the tetra methyl ammonium hydroxide first concentration is 12.5% and the pH of the solution is greater than 13.

10. (Original) The method of claim 1, wherein the ammonium hydroxide second concentration is between 25% and 45% in water.

11. (Original) The method of claim 10, wherein the ammonium hydroxide second concentration is approximately 35% in water.

12. (Original) The method of claim 1, wherein the fixed percentage of ammonium hydroxide solution is less than 1% of the volume of the tetra methyl ammonium hydroxide solution.

13. (Original) The method of claim 12, wherein the fixed percentage of ammonium hydroxide solution is approximately 0.2% of the volume of the tetra methyl ammonium hydroxide solution.

14. (Original) The method of claim 12, wherein an etch rate of a native silicon oxide layer on a top surface of the polysilicon layer is greater than 800 Angstroms per minute.

15. (Original) The method of claim 12, wherein an etch rate of the polysilicon layer is approximately 4000 Angstroms per minute.

16. (Original) The method of claim 15, wherein an etch rate of a doped oxide layer underneath the polysilicon layer is less than 20 Angstroms per minute.

17. (Previously Presented) A method of etching polysilicon, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution;
 - immersing at least one surface of a polysilicon layer having a patterned photo-resist mask in the ammonium hydroxide and tetra methyl ammonium hydroxide solution, the solution having a preselected temperature; and
 - removing the polysilicon layer after a preselected time period.
18. (Original) The method of claim 17, wherein the preselected temperature is approximately 70°C.
19. (Original) The method of claim 17, wherein the tetra methyl ammonium hydroxide solution has a concentration between 7.5% and 15% in water.
20. (Original) The method of claim 19, wherein the tetra methyl ammonium hydroxide concentration is approximately 12.5% and the pH of the solution is greater than 13.
21. (Original) The method of claim 17, wherein the ammonium hydroxide concentration is approximately 35% in water.
22. (Original) The method of claim 17, wherein the first volume of ammonium hydroxide solution is less than 1% of the second volume of the tetra methyl ammonium hydroxide solution.
23. (Original) The method of claim 22, wherein the first volume of ammonium hydroxide solution is greater than 0.2% of the volume of the tetra methyl ammonium hydroxide solution.
24. (Original) The method of claim 22, wherein an etch rate of a native silicon oxide layer on the surface of the polysilicon layer is greater than 800 Angstroms per minute.

25. (Original) The method of claim 22, wherein an etch rate of the polysilicon layer is approximately 4000 Angstroms per minute.
26. (Original) The method of claim 25, wherein an etch rate of a doped oxide layer disposed beneath the polysilicon layer is less than 20 Angstroms per minute.
27. (Withdrawn) A method of etching a polysilicon layer on an integrated circuit substrate, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution at a first time;
 - immersing the substrate in the ammonium hydroxide and tetra methyl ammonium hydroxide solution within one hour of the first time;
 - removing the substrate after expiration of a preselected time period;
 - removing essentially all of the ammonium hydroxide and tetra methyl ammonium hydroxide solution from the substrate; and
 - drying the substrate.
28. (Withdrawn) The method of claim 27, wherein the first volume is less than 2% of the second volume.
29. (Withdrawn) The method of claim 27, wherein a plurality of substrates may be sequentially immersed in the ammonium hydroxide and tetra methyl ammonium hydroxide solution during a one hour time period following the first time.
30. (Withdrawn) The method of claim 29, wherein another first volume of the ammonium hydroxide solution is added to the ammonium hydroxide and tetra methyl ammonium hydroxide solution before a one of the plurality of substrates is immersed in the ammonium hydroxide and tetra methyl ammonium hydroxide solution at a point in time that is more than one hour after the first time.

31. (Withdrawn) The method of claim 27, wherein the tetra methyl ammonium hydroxide solution has a temperature of approximately 70°C.
32. (Withdrawn) The method of claim 27, wherein the tetra methyl ammonium hydroxide solution has a concentration of approximately 12.5%, and the pH of the solution is greater than 13.
33. (Withdrawn) A method of fabricating an electronic memory, comprising:
 forming a substrate including an array of active electronic devices;
 forming at least one polysilicon layer on the substrate having a patterned photoresist layer on the at least one polysilicon layer; and
 patterning the polysilicon layer in a single step etch solution, comprising exposing the substrate having the patterned photoresist layer on the polysilicon layer for a predetermined time period to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration, and at least a fixed percentage of an ammonium hydroxide solution.
34. (Withdrawn) The method of claim 33, further comprising adding the ammonium hydroxide solution to the tetra methyl ammonium hydroxide and water solution after the preselected temperature is obtained, and before the substrate is exposed to the solution.
35. (Withdrawn) The method of claim 34, wherein the tetra methyl ammonium hydroxide solution has a temperature of between 60°C to 80°C, and the fixed percentage of ammonium hydroxide is greater than 1% of the volume of the tetra methyl ammonium hydroxide and water solution.
36. (Withdrawn) The method of claim 34, wherein the tetra methyl ammonium hydroxide solution has a concentration between 10% to 15% in deionized water, the ammonium hydroxide solution has a concentration between 25% to 40% in deionized water, and the pH of the solution is greater than 13.

37. (Withdrawn) A method of etching an oxide cap layer on a polysilicon layer, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution at a first time period;
 - immersing the polysilicon layer in the ammonium hydroxide and tetra methyl ammonium hydroxide solution within one hour of the first time period;
 - removing the polysilicon layer from the ammonium hydroxide and tetra methyl ammonium hydroxide solution after a first preselected time period to etch the oxide cap layer and a portion of the polysilicon layer;
 - washing the polysilicon layer to remove essentially all of the ammonium hydroxide and tetra methyl ammonium hydroxide solution from the substrate; and
 - drying the substrate.
38. (Withdrawn) The method of claim 37, wherein the first volume is less than 2% of the second volume.
39. (Withdrawn) The method of claim 37, wherein the polysilicon layer is removed from the ammonium hydroxide and tetra methyl ammonium hydroxide solution after a second preselected time period greater than the first preselected time period to etch the oxide cap layer and substantially the entire polysilicon layer.
40. (Withdrawn) The method of claim 37, wherein the tetra methyl ammonium hydroxide solution has a temperature of between 60°C to 80°C, the tetra methyl ammonium hydroxide solution has a concentration between 10% to 15% in deionized water, the ammonium hydroxide solution has a concentration between 25% to 40% in deionized water, and the pH of the solution is greater than 13.

REMARKS

This paper responds to the Office Action mailed on June 18, 2007.

No claims are amended, no claims are canceled, and no claims are added; as a result, claims 1-26 are now pending in this application, with claims 27-40 standing withdrawn.

Applicant notifies the Office of the publication of two members of the same patent family 2007/0163997 on July 19, 2007 and 2007/0178705 on August 2, 2007.

§103 Rejection of the Claims

Claims 1-3, 8, 12-19 and 22-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen (U.S. Publication 2005/0104114) in view of Wolf "Silicon Processing for the VLSI Era", Lattice Press (1986). Applicant respectfully traverses this rejection.

Chen appears to disclose forming a photo mask pattern for ion implanting portions of a polysilicon layer exposed by the photo mask at an angle to implant under the photo mask (para 27 and 28). This reduces the photo dimension to a level less than obtainable by the photo mask. The photo mask is removed and the unmasked bare polysilicon layer is selectively wet etched to remove the non-implanted regions (para 26 and 30). The non implanted region etches "at least two times faster" than the ion implanted region (para 32). The reference teaches the removal of the photo mask prior to the etch in order to "reduce the dimensions of the selected pattern from the dimensions of the masking layer" (para 28) and thus the photo mask 281 (fig. 2E) is removed prior to etching (para 45). Thus Chen can not disclose or suggest the claimed feature of "...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution* ...", as recited in claim 1, since Chen must remove the photoresist pattern before the liquid chemical etch.

Applicant respectfully disagrees with the statement on Page 10, first paragraph, that "applicants' arguments on pages 8- 9 of the reply asserting that the combined reference of Chen and Wolf do not teach the presence of photo-resist on the polysilicon layer at the time the etching is performed is not convincing", and notes that if the cited reference of Chen did not remove the photo resist 281 prior to the etch process, then Chen would result in an inoperative process, and fail of the intended purpose of the process. Chen clearly states in para [0045] that the "second mask layer 281 is then removed and the layer of polysilicon 285 is wet etched", which clearly

teaches against etching the polysilicon before removal of the photo mask, as found in the present claims. Thus, Chen does not disclose, teach or suggest having photo resist on the polysilicon at the time etching is performed. Chen would not obtain the claimed reduced dimensions if the photo mask remained on the device during the etching process as clearly stated at para [0028].

The cited Wolf reference is used in the outstanding Office Action to show that it is known to remove wafers from an etch solution after a preselected time period, and the use of ammonium hydroxide as an etchant solution. Applicant respectfully submits that the addition of Wolf does nothing to cure the above noted failure of Chen to describe or suggest each of the claimed features of the present arrangement.

Specifically, Applicant respectfully submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration ...*”, as recited in independent claim 1. Chen does not suggest exposing the substrate to a liquid chemical etch solution while the photo resist pattern is on the wafer, but rather uses the photo resist 281 to control an implantation process, and states at paragraphs 26, 28 and 45 that the photoresist is removed before the etch. The Examiner is mistaken to state on page 2 of the outstanding Office Action that “Chen discloses a method of forming a patterned polysilicon layer (paragraph 0026) in a single etch solution consisting of: (a) exposing a substrate having a photo-resist pattern on a polysilicon layer (Fig. 2B, paragraph 0042, Fig. 2E, paragraph 0045) to a liquid chemical solution”, at least since the photo-resist layer 280 in Fig. 2B is on insulator 275 and not on the polysilicon layer, which has not been deposited yet.

Applicant respectfully submits that very similar features are recited in independent claim 17, which is thus also not described or suggested by the combination of references. The dependent claims are held to be patentable at least as depending from patentable base claims, as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the failure of the suggested combination of references to describe or suggest etching a polysilicon layer in a single etch solution with a photoresist pattern, Applicant respectfully requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 5 and 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf, as applied to claim 1, and further in view of Li (U.S. 5,783,495). Applicant respectfully traverses this rejection.

Chen discloses forming a photo mask pattern for ion implanting portions of a polysilicon layer exposed by the photo mask at an angle to implant under the photo mask (para 27 and 28) to reduce the photo dimension to less than the photo mask. The photo mask is removed and the unmasked bare polysilicon layer is selectively wet etched to remove the non-implanted regions (para 26 and 30). The reference teaches the removal of the photo mask prior to the etch in order to “reduce the dimensions of the selected pattern from the dimensions of the masking layer” (para 28) and thus the photo mask 281 (fig. 2E) is removed prior to etching (para 45).

Wolf is used to show that it is known to remove wafers from an etch solution after a preselected time period, and the use of ammonium hydroxide as an etchant solution. The cited reference of Li is used in the outstanding Office Action to show that it is known to use a dispersing nozzle to dispense TMAH. Applicant respectfully submits that the addition of Wolf and Li, whether taken alone or in any combination, do nothing to supply the above noted missing feature of Chen to suggest at least the use of a photoresist mask during a single etch process.

Applicant submits that the suggested combination of references neither describes nor suggests the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution* ...”, as recited in independent claim 1, from which claims 5 and 6 depend. The addition of Wolf and Li do not cure the fact that Chen can not operate with a photo-resist pattern on the polysilicon during the chemical etch. Chen must remove the photo resist to obtain the intended smaller dimensions than obtainable with the photo mask, and thus there can be no motivation to combine these incompatible references.

The dependent claims are held to be patentable at least as depending from a patentable base claim, as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the failure of the suggested combination of references to describe or suggest etching a polysilicon layer in a single etch solution with a photoresist pattern, Applicant respectfully requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 3, 7 and 9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf, as applied to claim 1, and further in view of Schoeppel (U.S. 5,039,349). Applicant respectfully traverses this rejection.

Chen discloses forming a photo mask pattern for ion implanting portions of a polysilicon layer exposed by the photo mask at an angle to implant under the photo mask (para 27 and 28) to reduce the photo dimension to less than the photo mask. The photo mask is removed and the unmasked bare polysilicon layer is selectively wet etched to remove the non-implanted regions (para 26 and 30). The reference teaches the removal of the photo mask prior to the etch in order to "reduce the dimensions of the selected pattern from the dimensions of the masking layer" (para 28) and thus the photo mask 281 (fig. 2E) is removed prior to etching (para 45).

Wolf is used to show that it is known to remove wafers from an etch solution after a preselected time period, and the use of ammonium hydroxide as an etchant solution. Schoeppel is used in the outstanding Office Action to show that it is known to have the TMAH solution in the range of 85-90 deg C. The addition of Schoeppel does nothing to cure the previously noted failure of the combination of Chen and Wolf to suggest etching the polysilicon with a layer of photoresist present, since Chen requires that the photoresist be removed prior to etch.

Applicant submits that the suggested combination of references neither describes nor suggests at least the feature of "...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution ...*", as recited in independent claim 1, from which dependent claims 3, 7 and 9 depend. Since the suggested combination of references do not describe or suggest each and every one of the claimed features, then the suggested combination of references, even if there were motivation to make the suggested combination, still does not result in the claimed arrangement.

The dependent claims are held to be patentable at least as depending from a patentable base claim, as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the failure of the suggested combination of references to describe or suggest etching a polysilicon layer in a single etch solution with a photoresist pattern, Applicant respectfully requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 10, 11 and 21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf, as applied to claim 1, and further in view of Hardy (U.S. 6,238,592). Applicant respectfully traverses this rejection.

Chen discloses forming a photo mask pattern for ion implanting portions of a polysilicon layer exposed by the photo mask at an angle to implant under the photo mask (para 27 and 28) to reduce the photo dimension to less than the photo mask. The photo mask is removed and the unmasked bare polysilicon layer is selectively wet etched to remove the non-implanted regions (para 26 and 30). The reference teaches the removal of the photo mask prior to the etch in order to “reduce the dimensions of the selected pattern from the dimensions of the masking layer” (para 28) and thus the photo mask 281 (fig. 2E) is removed prior to etching (para 45).

Wolf is used to show that it is known to remove wafers from an etch solution after a preselected time period, and the use of ammonium hydroxide as an etchant solution. Hardy is used in the outstanding Office Action to show that the use of ammonium hydroxide and a complexing agent in the etching solution with a concentration in the range 0.01 to 50wt% in deionized water, is known in the art.

Applicant submits that the addition of Hardy does nothing to cure the above noted failure of the Chen and Wolf references to either describe nor suggest the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution*...”, as recited in independent claim 1, with similar language found in claim 17. The combination of references suggests selective etching ion implanted regions with no photo resist mask. Since the suggested combination suggests etching without photo resist, then the present independent claims have features not suggested by the combination of references.

The dependent claims are held to be patentable at least as depending from a patentable base claim, as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the failure of the suggested combination of references to describe or suggest etching a polysilicon layer in a single etch solution with a photoresist pattern, Applicant respectfully requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

RESERVATION OF RIGHTS

In the interest of clarity and brevity, Applicant may not have addressed every assertion made in the Office Action. Applicant's silence regarding any such assertion does not constitute any admission or acquiescence. Applicant reserves all rights not exercised in connection with this response, such as the right to challenge or rebut any tacit or explicit characterization of any reference or of any of the present claims, the right to challenge or rebut any asserted factual or legal basis of any of the rejections, the right to swear behind any cited reference such as provided under 37 C.F.R. § 1.131 or otherwise, or the right to assert co-ownership of any cited reference. Applicant does not admit that any of the cited references or any other references of record are relevant to the present claims, or that they constitute prior art. To the extent that any rejection or assertion is based upon the Examiner's personal knowledge, rather than any objective evidence of record as manifested by a cited prior art reference, Applicant timely objects to such reliance on Official Notice, and reserves all rights to request that the Examiner provide a reference or affidavit in support of such assertion, as required by MPEP § 2144.03. Applicant reserves all rights to pursue any cancelled claims in a subsequent patent application claiming the benefit of priority of the present patent application, and to request rejoinder of any withdrawn claim, as required by MPEP § 821.04.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney David Suhl at (508) 865-8211, or the undersigned attorney at (612) 349-9587 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

KEVIN SHEA

By his Representatives,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
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Date

18 Sept '07

By



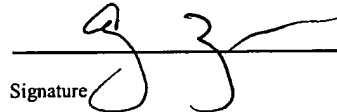
Timothy B. Clise
Reg. No. 40,957

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being filed using the USPTO's electronic filing system EFS-Web, and is addressed to: Mail Stop Amendment, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 18th day of September 2007.

Name

Amy Moriarty

Signature





S/N 11/168,023

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Kevin Shea

Examiner: Maki A Angadi

Serial No.: 11/168,023

Group Art Unit: 1765

Filed: June 28, 2005

Docket No.: 303.898US1

Title: POLY ETCH WITHOUT SEPARATE OXIDE DECAP

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.111

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

This paper responds to the Office Action mailed on September 14, 2006. Please amend the above-identified patent application as follows.

IN THE CLAIMS

Please amend the claims as follows:

1. (Original) A method of forming a patterned polysilicon layer in a single chemical etch solution, comprising:
 - exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration; and
 - removing the substrate from the etch solution after a preselected time period.
2. (Original) The method of claim 1, further comprising:
 - adding a fixed percentage of an ammonium hydroxide solution to the etch solution, the ammonium hydroxide solution having a second concentration; and
 - removing the substrate from the etch solution after a preselected time period.
3. (Original) The method of claim 1, wherein the tetra methyl ammonium hydroxide temperature is in a range of approximately 60°C to 90°C.
4. (Original) The method of claim 3, wherein the temperature of the substrate is approximately 70°C.
5. (Original) The method of claim 1, wherein the chemical etch solution comprises a single wafer spinning vacuum chuck with at least a tetra methyl ammonium hydroxide dispensing nozzle.
6. (Original) The method of claim 5, wherein the dispensing nozzle provides a spray of liquid droplets, each having a temperature between 65°C and 75°C.
7. (Original) The method of claim 1, wherein the chemical etch solution comprises an open bath having a temperature control and heater device disposed to maintain the open bath in a temperature range of approximately 65°C to 75°C.

8. (Original) The method of claim 1, wherein the tetra methyl ammonium hydroxide first concentration is between 2.5% and 25% in water.
9. (Original) The method of claim 8, wherein the tetra methyl ammonium hydroxide first concentration is 12.5% and the pH of the solution is greater than 13.
10. (Original) The method of claim 1, wherein the ammonium hydroxide second concentration is between 25% and 45% in water.
11. (Original) The method of claim 10, wherein the ammonium hydroxide second concentration is approximately 35% in water.
12. (Original) The method of claim 1, wherein the fixed percentage of ammonium hydroxide solution is less than 1% of the volume of the tetra methyl ammonium hydroxide solution.
13. (Original) The method of claim 12, wherein the fixed percentage of ammonium hydroxide solution is approximately 0.2% of the volume of the tetra methyl ammonium hydroxide solution.
14. (Original) The method of claim 12, wherein an etch rate of a native silicon oxide layer on a top surface of the polysilicon layer is greater than 800 Angstroms per minute.
15. (Original) The method of claim 12, wherein an etch rate of the polysilicon layer is approximately 4000 Angstroms per minute.
16. (Original) The method of claim 15, wherein an etch rate of a doped oxide layer underneath the polysilicon layer is less than 20 Angstroms per minute.

17. (Currently Amended) A method of etching polysilicon, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution;
 - immersing at least one surface of a polysilicon layer having a patterned photo-resist mask in the ammonium hydroxide and tetra methyl ammonium hydroxide solution, the solution having a preselected temperature; and
 - removing the polysilicon layer after a preselected time period.
18. (Original) The method of claim 17, wherein the preselected temperature is approximately 70°C.
19. (Original) The method of claim 17, wherein the tetra methyl ammonium hydroxide solution has a concentration between 7.5% and 15% in water.
20. (Original) The method of claim 19, wherein the tetra methyl ammonium hydroxide concentration is approximately 12.5% and the pH of the solution is greater than 13.
21. (Original) The method of claim 17, wherein the ammonium hydroxide concentration is approximately 35% in water.
22. (Original) The method of claim 17, wherein the first volume of ammonium hydroxide solution is less than 1% of the second volume of the tetra methyl ammonium hydroxide solution.
23. (Original) The method of claim 22, wherein the first volume of ammonium hydroxide solution is greater than 0.2% of the volume of the tetra methyl ammonium hydroxide solution.
24. (Original) The method of claim 22, wherein an etch rate of a native silicon oxide layer on the surface of the polysilicon layer is greater than 800 Angstroms per minute.

25. (Original) The method of claim 22, wherein an etch rate of the polysilicon layer is approximately 4000 Angstroms per minute.
26. (Original) The method of claim 25, wherein an etch rate of a doped oxide layer disposed beneath the polysilicon layer is less than 20 Angstroms per minute.
27. (Withdrawn) A method of etching a polysilicon layer on an integrated circuit substrate, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution at a first time;
 - immersing the substrate in the ammonium hydroxide and tetra methyl ammonium hydroxide solution within one hour of the first time;
 - removing the substrate after expiration of a preselected time period;
 - removing essentially all of the ammonium hydroxide and tetra methyl ammonium hydroxide solution from the substrate; and
 - drying the substrate.
28. (Withdrawn) The method of claim 27, wherein the first volume is less than 2% of the second volume.
29. (Withdrawn) The method of claim 27, wherein a plurality of substrates may be sequentially immersed in the ammonium hydroxide and tetra methyl ammonium hydroxide solution during a one hour time period following the first time.
30. (Withdrawn) The method of claim 29, wherein another first volume of the ammonium hydroxide solution is added to the ammonium hydroxide and tetra methyl ammonium hydroxide solution before a one of the plurality of substrates is immersed in the ammonium hydroxide and tetra methyl ammonium hydroxide solution at a point in time that is more than one hour after the first time.

31. (Withdrawn) The method of claim 27, wherein the tetra methyl ammonium hydroxide solution has a temperature of approximately 70°C.
32. (Withdrawn) The method of claim 27, wherein the tetra methyl ammonium hydroxide solution has a concentration of approximately 12.5%, and the pH of the solution is greater than 13.
33. (Withdrawn) A method of fabricating an electronic memory, comprising:
 forming a substrate including an array of active electronic devices;
 forming at least one polysilicon layer on the substrate having a patterned photoresist layer on the at least one polysilicon layer; and
 patterning the polysilicon layer in a single step etch solution, comprising exposing the substrate having the patterned photoresist layer on the polysilicon layer for a predetermined time period to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration, and at least a fixed percentage of an ammonium hydroxide solution.
34. (Withdrawn) The method of claim 33, further comprising adding the ammonium hydroxide solution to the tetra methyl ammonium hydroxide and water solution after the preselected temperature is obtained, and before the substrate is exposed to the solution.
35. (Withdrawn) The method of claim 34, wherein the tetra methyl ammonium hydroxide solution has a temperature of between 60°C to 80°C, and the fixed percentage of ammonium hydroxide is greater than 1% of the volume of the tetra methyl ammonium hydroxide and water solution.
36. (Withdrawn) The method of claim 34, wherein the tetra methyl ammonium hydroxide solution has a concentration between 10% to 15% in deionized water, the ammonium hydroxide solution has a concentration between 25% to 40% in deionized water, and the pH of the solution is greater than 13.

37. (Withdrawn) A method of etching an oxide cap layer on a polysilicon layer, comprising:
- adding a first volume of an ammonium hydroxide solution to a second volume of a tetra methyl ammonium hydroxide solution at a first time period;
 - immersing the polysilicon layer in the ammonium hydroxide and tetra methyl ammonium hydroxide solution within one hour of the first time period;
 - removing the polysilicon layer from the ammonium hydroxide and tetra methyl ammonium hydroxide solution after a first preselected time period to etch the oxide cap layer and a portion of the polysilicon layer;
 - washing the polysilicon layer to remove essentially all of the ammonium hydroxide and tetra methyl ammonium hydroxide solution from the substrate; and
 - drying the substrate.
38. (Withdrawn) The method of claim 37, wherein the first volume is less than 2% of the second volume.
39. (Withdrawn) The method of claim 37, wherein the polysilicon layer is removed from the ammonium hydroxide and tetra methyl ammonium hydroxide solution after a second preselected time period greater than the first preselected time period to etch the oxide cap layer and substantially the entire polysilicon layer.
40. (Withdrawn) The method of claim 37, wherein the tetra methyl ammonium hydroxide solution has a temperature of between 60°C to 80°C, the tetra methyl ammonium hydroxide solution has a concentration between 10% to 15% in deionized water, the ammonium hydroxide solution has a concentration between 25% to 40% in deionized water, and the pH of the solution is greater than 13.

REMARKS

This paper responds to the Office Action mailed on September 14, 2006.

Claim 17 is amended, no claims are canceled, and no claims are added; as a result, claims 1-40 are now pending in this application with claims 27-40 standing withdrawn.

Election/Restrictions

Restriction to one of the following inventions was required:

- I. Claims 1-26, drawn to method of forming patterned silicon layer classified in class 216, subclass 83.
- II. Claims 27-32, drawn to etching polysilicon layer on IC substrate classified in class 438, subclass 689.
- III. Claims 33-40, drawn to method of fabricating an electronic memory classified in class 257, subclass 314.

Applicant elects, with traverse, Group I, claims 1-26. However, Applicant reserves the right to later file continuations or divisions having claims directed to the non-elected inventions.

§103 Rejection of the Claims

Claims 1-3, 8, 12-19 and 22-26 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen (U.S. Publication 2005/0104114) in view of Wolf "Silicon Processing for the VLSI era", Lattice Press (1986). Applicant respectfully traverses this rejection.

The cited Chen reference discloses a method of forming a photo mask pattern and ion implanting portions of a polysilicon layer, then removing the photo mask pattern and selectively wet etching the unmasked, bare, polysilicon layer to remove the non-implanted regions. The Wolf reference is used in the outstanding Office Action to show that it is known to remove wafers from an etch solution after a preselected time period, and use of ammonium hydroxide.

Applicant respectfully submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution containing at least tetra methyl ammonium hydroxide and water at a preselected temperature and first concentration* ...”, as recited in independent claim 1, with similar language in independent claim 17, as amended herein. Since the method of the cited Chen reference does not have photo-resist on the polysilicon layer at the time the etching is performed, then the reference, whether taken alone or in any combination, does not disclose or suggest at least this portion of the claim language.

The dependent claims are seen as being in patentable condition at least as depending from base claims shown above to be patentable over the suggested combination of references. In view of the above, Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 5 and 6 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf as applied to claim 1, and further in view of Li (U.S. 5,783,495). Applicant respectfully traverses this rejection.

The cited Chen and Wolf references have been described above. The cited reference of Li is used in the outstanding Office Action to show that it is known to use a dispersing nozzle to dispense TMAH.

Applicant respectfully submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution* ...”, as recited in independent claim 1, from which claims 5 and 6 depend either directly in the case of claim 5, or indirectly from claim 5 in the case of claim 6. The addition of the Wolf and/or the Li reference is not seen as curing the above noted failure of the Chen reference to suggest at least the basic process occurring as recited in the present claims at question.

The dependent claims are thus believed to be in patentable condition as depending from patentable base claims. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 3, 7 and 9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf as applied to claim 1, and further in view of Schoepfel (U.S. 5,039,349). Applicant respectfully traverses this rejection.

The Chen reference has features discussed above with reference to the previous two rejections. The cited reference of Schoepfel is used in the Office Action to show the missing element in Chen of the temperature of the TMAH solution being in the range of 85-90 deg C.

Applicant submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution* ...”, as recited in independent claim 1, from which dependent claims 3, 7 and 9 depend. Since the suggested combination of references does not suggest a liquid chemical etch solution but rather a method of ion implanting a material into a portion of the polysilicon to make that area less etch able when etched without the photo resist layer present, then the suggested combination of references does not result in the claimed arrangement.

Since the base claim has been shown above to be patentable over the suggested combination of references, then the dependent claims are also held to be in patentable condition. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

Claims 10, 11 and 21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Chen in view of Wolf as applied to claim 1, and further in view of Hardy (U.S. 6,238,592). Applicant respectfully traverses this rejection.

Chen and Wolf have features discussed previously. The Hardy reference is used to supply the missing feature of the use of ammonium hydroxide and a complexing agent in the etching solution and its concentration in the range 0.01 to 50wt% in deionized water.

Applicant submits that the suggested combination of references neither describes nor suggests at least the feature of “...*exposing a substrate having a photo-resist pattern on a polysilicon layer to a liquid chemical etch solution* ...”, as recited in independent claim 1, with similar language found in independent claim 17. As noted above, the combination of references suggests a method of etching ion implanted regions without a mask. Since the suggested combination suggests etching without photo resist to improve fine line control, then the present

independent claims have at least one claimed feature not suggested by the combination of references.

Dependent claims 10, 11 and 21 depend upon base claims 1 and 17, which have been shown above to be patentable over the suggested combination of references. In view of the above, the dependent claims are also held to be in patentable condition. Applicant respectfully requests that this rejection be reconsidered and withdrawn.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney David Suhl at (508) 865-8211, or the undersigned attorney at (612) 349-9587 to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

KEVIN SHEA

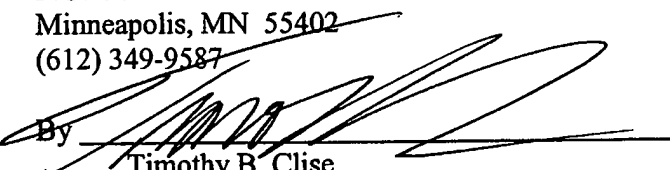
By his Representatives,

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(612) 349-9587

Date

14 Dec '06

By



Timothy B. Clise
Reg. No. 40,957

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Name

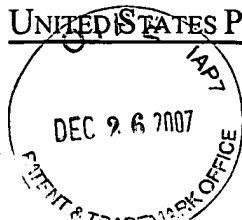
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/494,056	07/27/2006	Kevin Shea	303.867US3	8891

21186 7590 08/17/2007
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EXAMINER
SULLIVAN, CALEEN O

ART UNIT	PAPER NUMBER
1756	

MAIL DATE	DELIVERY MODE
08/17/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.



Schwegman Lundberg
Woessner & Kluth P.A.

AUG 20 2007

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Office Action Summary

Application No.	Applicant(s)	
11/494,056	SHEA ET AL.	
Examiner	Art Unit	
Caleen O. Sullivan	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 July 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-34 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 July 2007 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>06/18/07</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Response to Amendment

1. Applicant's amendments to the Specification have overcome the Examiner's objection; therefore Examiner has withdrawn this objection.
2. Applicant has submitted a new set of corrected drawings, which are accepted by the Examiner; therefore, Examiner has withdrawn this objection.
3. Applicant's amendments to claims 1, 5, 10, 24 and 26 have failed to overcome the rejection under 35 USC 112 for failure to write a Markush group in proper format; therefore, Examiner restates the ground of rejection presented in the last Office Action in response to the amendment.
4. Applicant's amendments to claims 2, 14, 25 and 29 have overcome the rejection under 35 USC 112 for reciting a trademark/trade name in a claim; therefore, Examiner withdraws this rejection.
5. Applicant's amendments and arguments presented have failed to overcome the rejection of claims 3-12 and 15-16 under 35 USC 112 first paragraph for failure to define the concentration ratios as well as the rejection under 35 USC 112 second paragraph for indefiniteness. Therefore, Examiner restates the grounds of rejection presented in the last Office Action in response to the amendments.
6. Examiner acknowledges that claims 12-23 and 35-38 of copending Application No. 10/788,889 have been cancelled; therefore, Examiner has withdrawn the double patenting rejection of claims 1-12 and 24-27, under 35 USC 101. However, until a terminal disclaimer is offered the obviousness double patenting rejection of claims 13-26, 19-20 and 22-23 over claims 1-11, 24-34 and 39-42 of copending Application No. 10/788,889 cannot be withdrawn. Therefore, Examiner restates this ground of rejection.

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7. Applicant's amendments and arguments presented have failed to overcome the rejection of claims 1-3, 13-21 and 23 under 35 USC 103(a) over Liu ('078) in view of Szwejkowski ('499); the rejection of claim 22 under 35 U.S.C. 103(a) over Liu ('078) in view of Szwejkowski ('499), further in view of Tsai ('132); the rejection of claims 4 and 16 under 35 U.S.C. 103(a) over Liu ('078) in view of Szwejkowski ('499), further in view of Chen ('435); the rejection of claims 5-9 under 35 U.S.C. 103(a) over Liu ('078) in view of Szwejkowski ('499), further in view of Chen ('435); the rejection of claims 10-12 and 26-27 under 35 U.S.C. 103(a) over Liu ('078) in view of Szwejkowski ('499), further in view of Fang ('338); and the rejection of claims 24-25 and 28-34 under 35 U.S.C. 103(a) over Liu ('078) in view of Szwejkowski ('499) further in view of Chen ('435).

Claim Rejections - 35 USC § 112

8. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 3-12 and 15-16 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contain subject matter, which was not described in the specification. In the aforementioned claims applicant includes limitations specifying "concentration ratios" for the "surface treating solutions" used in the process of removing residual photoresist; however, applicant has failed to describe in the specification if these "concentration ratios" are volume, weight, or mole ratios. For the purpose of examination, Examiner has considered the "concentration ratios" to be volume ratios in the rejections that follow.

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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Claims 1, 3-12, 15-16, 24 and 26 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claims 3-12 and 15-16 include the term "concentration ratio;" however, it is unclear as to whether the concentration ratio is a volume, a weight, or a mole ratio. For the purpose of examination, Examiner has considered the "concentration ratio" to be a volume ratio in the rejections that follow.

Claims 1, 5, 10, 24 and 26 include the phrase "... resist stack including at least one antireflective coating...selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating, ..." which Examiner considers to be a claim that includes a Markush group written in improper format. "Alternative expressions are permitted if they present no uncertainty or ambiguity with respect to the question of scope or clarity of the claims. One acceptable form of alternative expression, which is commonly referred to as a Markush group, recites members as being "selected from the group consisting of A, B and C." See Ex parte Markush, 1925 C.D. 126 (Comm'r Pat. 1925). These claims should be amended to recite proper Markush Language such as, "the group consisting of".

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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11. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

12. Claims 1-3, 13-21 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499).

Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch, as recited in claim 23, and then the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). This disclosure teaches the limitation of claims 13 and 19-20, where a carbon containing hard mask over a substrate with a resist is patterned, where the hard mask comprises carbon, and the carbon comprises amorphous carbon.

Liu ('078) also teaches that the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56- col. 6, 45; Fig.3A-3F). This teaching meets the limitation of claims 1, 18, where an amorphous carbon hard mask that includes a resist stack, which includes at least one ARC over the hard mask, which is selected from a dielectric anti-reflective coating (DARC) and a bottom anti-reflective coating (BARC), and a photoresist layer is over the at least one ARC, is patterned. Moreover, this disclosure meets the limitation of claim 21.

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However, Liu ('078) fails to teach a process step where the surface of the substrate is treated with a solution to remove residual resist under conditions that are not damaging to the underlying layers. Szwejkowski ('499) discloses a method, which teaches such process steps.

Szwejkowski ('499) discloses a method to remove sidewall residues remaining after a polysilicon layer that has been masked with a photoresist layer is etched. The residues from the etch process are removed without undercutting the remaining polysilicon, using a solution of ammonium hydroxide and peroxide. (See, col.2, 26-39 and 57-col.3, 2). This disclosure teaches the limitation of claims 1-3 and 14-15 where the substrate is treated with a solution including an ammonium hydroxide and peroxide solution to remove residual resist under conditions that are not damaging to the underlying layers.

Szwejkowski ('499) discloses that the solution of aqueous hydrogen peroxide and ammonium hydroxide has a concentration ratio by volume of about 1 part hydroxide to 2 parts peroxide to 7 parts water, which is within the concentration ratio ranges recited in claims 3 and 15. (See, col. 3, 38-40). Szwejkowski ('499) further discloses that the solution is heated and maintained between about 50°C – about 70°C (See, col.3, 45-49), and the substrate is in the solution for about 5 seconds to about 15 minutes to remove the excess residue. (See, col.3, 50-57). These teachings fall within the time and temperature ranges, which are between about 2 to about 45 minutes and between about room temperature to about 70°C, recited in claims 3, and 15 for applying the surface treating solution such as an ammonium hydroxide and peroxide solution or a solution that is comprised of ammonium hydroxide and peroxide and other components to the substrate.

Although Liu ('078) in view of Szwejkowski ('499) fails to explicitly disclose the limitation of claim 17, where the etch rate of the resist is one-hundred times greater than the etch rate of the hard mask layer, Liu ('078) in view of Szwejkowski ('499) does disclose that the overlying patterned layer

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is removed using a surface treating solution while the underlying layers are left undamaged (col.2, 57-col.3, 2; 19-27). This disclosure in Szwejkowski ('499) would encompass such a difference in the etching rates of the upper resist layer to the lower hard mask layer.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) in view of the teachings of Szwejkowski ('499) because polysilicon and carbon are in the same chemical series; therefore, it is obvious the cleaning solution and process disclosed in Szwejkowski ('499), used on a polysilicon layer can be used on a carbon layer to remove photoresist residue, while leaving the underlying layers undamaged.

13. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) as applied to claims 1-3, 13-21 and 23 in paragraph 7 above, and further in view of Tsai ('132). Liu ('078) in view of Szwejkowski ('499) fails to disclose the limitation of claim 22 where the patterned resist layer is developed by a dry development process. However, Tsai ('132) discloses such a process.

Tsai ('132) discloses a process of patterning a dual resist layer that will be patterned and developed to form a semiconductor feature etching pattern. Tsai ('132) discloses that the process consists of depositing two photoresist layers on the semiconductor substrate. (See, col.6, 36-37). Tsai ('132) further discloses that the bottom image layer is a non-silicon containing organic material, and the upper resist layer is preferably a DUV resist formed of silicon containing organic material. (See, col.5, 57-col.6, 14). Tsai ('132) disclose the next step in the process, which is the exposure of the upper resist layer to radiation of 193 nm or 157 nm and the exposed portions are developed away using convention developer leaving the unexposed portions of the upper resist layer as a dry development mask. (See, col.6, 38- 47).

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Tsai ('132) goes on to disclose that the next a dry development step is performed to develop the exposed portions of the lower resist layer to form a pattern that will be used to etch features into the underlying semiconductor substrate. (See, col.6, 48-57). This disclosure meets the limitation of claim 22.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szwejkowski ('499) in view of the teachings of Tsai ('132) because Tsai ('132) teaches that one can perform a dry development step of a resist layer that will be used to pattern underlying layers.

14. Claims 4 and 16, are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) as applied to claims 1-3, 13-21 and 23 in paragraph 7 above, and further in view of Chen ('435). Liu ('078) in view of Szwejkowski ('499) fails to disclose solutions of ammonium hydroxide and peroxide with a concentration ratio of about 100:3:2, H_2O : NH_4OH : H_2O_2 . Dilute solutions of ammonium hydroxide and hydrogen peroxide that are used as cleaning solutions, are disclosed in Chen ('435).

Chen ('435) discloses a method of cleaning or stripping photoresist from photomasks by using solutions of ammonium hydroxide and hydrogen peroxide. In one embodiment Chen ('435) discloses applying a very dilute solution of ammonium hydroxide and hydrogen peroxide, with concentration ratios of 1:2-10:200-1000 that can be simplified to a ratio of 5:1-5:100-500, at low temperatures to clean or strip photoresist from a photomask. (See, para. 0024). This disclosure meets the limitation of claims 4 and 16, where solutions of ammonium hydroxide and hydrogen peroxide that may also contain other components, have a concentration ratio of 100:3:2 (claims 4 and 16), H_2O : NH_4OH : H_2O_2 .

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It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szwejkowski ('499) in view of the teachings of Chen ('435) because Chen ('435) teaches that dilute solutions of ammonium hydroxide and hydrogen peroxide can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

15. Claims 5-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) and further in view of Chen ('435).

Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch and the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). Liu ('078) also teaches that the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56-col. 6, 45; Fig.3A-3F).

The teachings in Liu ('078) meet the limitation of claim 5, where an amorphous carbon hard mask that includes a resist stack is patterned. Moreover, the teachings in Liu ('078) meet the limitations of claim 5, where the resist stack includes at least one ARC over the hard mask, which is selected from a dielectric anti-reflective coating (DARC) and a bottom anti-reflective coating (BARC), and a photoresist layer is over the at least one ARC.

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However, Liu ('078) fails to teach a process step where the surface of the substrate is treated with a solution to remove residual resist under conditions that are not damaging to the underlying layers. Szwejkowski ('499) discloses a method, which teaches such process steps.

Szwejkowski ('499) discloses a method to remove sidewall residues remaining after a polysilicon layer that has been masked with a photoresist layer is etched. The residues from the etch process are removed without undercutting the remaining polysilicon, using a solution of ammonium hydroxide and peroxide. (See, col.2, 26-39 and 57-col.3, 2). This disclosure teaches the limitations of claim 5, where the substrate is treated with a solution including an ammonium hydroxide and peroxide solution to remove residual resist under conditions that is not damaging to the underlying layers.

Szwejkowski ('499) discloses that the solution of aqueous hydrogen peroxide and ammonium hydroxide is heated and maintained between about 50°C – about 70°C (See, col.3, 45-49), and the substrate is in the solution for about 5 seconds to about 15 minutes to remove the excess residue. (See, col.3, 50-57). These teachings overlap with the temperature recited in claim 5 and falls within the time ranges, which are between about 5-30 minutes, recited in claims 6-9 for applying the surface treating solution of ammonium hydroxide and peroxide to the substrate.

Still, Liu ('078) in view of Szwejkowski ('499) fails to disclose solutions of ammonium hydroxide and peroxide with a concentration ratio of about 100:3:2, H₂O: NH₄OH: H₂O₂. Dilute solutions of ammonium hydroxide and hydrogen peroxide, used as cleaning solutions, are disclosed in Chen ('435).

Chen ('435) discloses a method of cleaning or stripping photoresist from photomasks by using solutions of ammonium hydroxide and hydrogen peroxide. In one embodiment Chen ('435) discloses applying a very dilute solution of ammonium hydroxide and hydrogen peroxide, with

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concentration ratios of 1:2-10:200-1000 that can be simplified to a ratio of .5:1-5:100-500, at low temperatures to clean or strip photoresist from a photomask. (See, para. 0024). This disclosure meets the limitation of claim 5, where the surface treating solution of ammonium hydroxide and hydrogen peroxide has a concentration ratio of 100:3:2, H_2O : NH_4OH : H_2O_2 .

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) in view of Szwejkowski ('499) and further in view of Chen ('435) because polysilicon and carbon are in the same chemical series; therefore, it is obvious the cleaning solution and process disclosed in Szwejkowski ('499), used on a polysilicon layer can be used on a carbon layer to remove photoresist residue, while leaving the underlying layers undamaged and Chen ('435) teaches that dilute solutions of ammonium hydroxide and hydrogen peroxide can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

16. Claims 10-12 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) and further in view of Fang ('338). Liu ('078) and Szwejkowski ('499) are relied upon as discussed in the rejection of claims 1-3, 13-21 and 23 under 35 USC 103 (a) in paragraph 7 above.

Still, Liu ('078) in view of Szwejkowski ('499) fails to teach a process step where the surface of the substrate is treated with an aqueous solution of sulfuric acid and citric acid, or an sulfuric acid solution containing solution, to remove residual resist under conditions that are not damaging to the underlying layers. Moreover, Liu ('078) in view of Szwejkowski ('499) fails to disclose that the treatment solutions of sulfuric acid and citric acid, have a concentration ratio of 100:3:2 (claim 11) or 100:2:2 (claim12), H_2O : H_2SO_4 : $\text{C}_6\text{H}_4\text{O}_7$. However, solutions comprised of sulfuric acid that include citric acid are disclosed in Fang ('338).

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Fang ('338) teaches a method to deposit a cobalt containing capping layer. As part of this process there is a pre-clean step where the substrate is exposed to a complexing agent solution to remove oxides or other residues such as organic residues, resist, and other polymeric residues from previous fabrication processes. (See, para.0028). This pre-clean step is analogous to the step recited in claim 21, where the substrate is treated with a solution to remove residual resist without damaging the underlying layers. The complexing agent is a solution that consists of at least one acid, a pH adjusting agent and other additives including citric acid and other acids such as sulfuric acid. (See, para.0029).

One exemplary complexing agent solution disclosed in Fang ('338) is comprised of water, citric acid in a concentration ratio of .05M to about 1.0M, EDTA, sulfuric acid in a concentration of .05N to about 1.0N and TMAH or ammonium in a concentration to adjust the pH to a range from about 1.5 to 10. (See, para. 0030). This disclosure meets the limitation of claim 10 where surface treating step includes using an aqueous sulfuric acid and citric acid solution, and the limitation of claims 26-27 where the surface treating solution is a sulfuric acid containing solution and includes at least aqueous citric acid. Although Fang ('338) does not disclose the concentration ratio recited in claims 11-12, one of ordinary skill in the art would be able to determine the appropriate concentration ratio to achieve a solution that would remove residual resist without damaging the underlying layers.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) in view of Szwejkowski ('499) and further in view of Fang ('338), because Szwejkowski ('499) and Fang ('338) teach that one can remove residual resist from structures such as the one disclosed in Liu ('078) with the solutions they disclose to prepare the structure for further processing without damaging the underlying layers of the structure.

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17. Claims 24-25 and 28-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) and further in view of Chen ('435). Liu ('078) and Szwejkowski ('499) are relied upon as discussed in the rejection of claims 1-3, 13-21 and 23.

Although Liu ('078) in view of Szwejkowski ('499) fails to explicitly disclose the limitation of claim 33, where the etch rate of the resist is five times greater than the etch rate of the hard mask, Liu ('078) in view of Szwejkowski ('499) does disclose that the overlying resist layer is removed using a surface treating solution while the underlying layers are left undamaged (col.2, 57-col.3, 2; 19-27).

This disclosure encompasses such a difference in etch rates between the resist layer and the hard mask layer. Moreover, this disclosure also meets the limitation of claim 34 where the etch rate of the resist is greater than the etch rate of the ARC layer.

Liu ('078) in view of Szwejkowski ('499) fails to disclose a step of surface treating using an ozone-containing solution that may include other components such as those recited in claim 25 and 29. Treatment solutions such as these are disclosed in Chen ('435).

Chen ('435) discloses other solutions, which can be used to clean or strip resist from a photomask. One solution is comprised of sulfuric acid and ozone (SOM). (See, para 0020). Another exemplary solution is comprised of sulfuric acid and hydrogen peroxide (SPM). (See, para. 0034). Chen ('435) also discloses the various solutions can be combined and applied to the structure to strip or remove photoresist. (See, para. 0034 and 0043).

The disclosures in Chen ('435) meet the limitation of claim 24 and 28, where the surface treating solution includes ozone and the limitation of claims 25 and 29, where the surface treating solution is comprised of ozone (SOM) and one of the solutions recited in claims 25 and 29, which can be, for example, a solution of aqueous sulfuric acid and hydrogen peroxide, referred to as SPM in Chen ('435) (See, para. 0020).

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It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szwejkowski ('499) in view of the teachings of Chen ('435) because Chen ('435) teaches that ozone-containing solutions that may include other components such as a solution of ammonium hydroxide and hydrogen peroxide can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

Double Patenting

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 13-16, 19-20 and 23-24 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-11, 24-34 and 39-42 of copending Application No. 10/788,889 (US-2005/0191584). Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims of copending Application No. 10/788,889 (US-2005/0191584) are fully encompassed by the recitations of claims 13-16, 19-20 and 23-24 of the present application.

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This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

18. Applicant's arguments filed 07/12/07 have been fully considered but they are not persuasive.

19. Foremost Applicant argues that Liu ('078) fails to disclose the use of a resist stack of any kind; however Liu does disclose the use of a resist stack. Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch, as recited in claim 23, and then the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). Liu ('078) also teaches that the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56- col. 6, 45; Fig.3A-3F). These teachings in Liu do disclose the use of resist stack.

20. Applicant then argues Liu ('078) fails to suggest a problem with residual resist material remaining after the removal of photoresist, and that in the Szwejkowski ('499) reference there is no suggestion that the silicon oxide film removed is photoresist. Examiner did not rely on Liu ('078) as teaching the limitation that residual resist remained after the photoresist material was stripped. The limitation of removing residual resist was taught in Szwejkowski ('499). Although, Szwejkowski ('499) does not explicitly state the polymeric silicon oxide-containing residue on the polysilicon layer,

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is resist, it is readily apparent that the residue includes resist material, which remains from the process where the resist layer is used as an etch mask for the underlying polysilicon layer.

The residue, which contains resist material, is then removed when the structure is exposed to the hydroxide/peroxide solution. Moreover, Applicant has assumed the etching step using the resist layer as a mask removes all the resist material that is used to pattern the underlying polysilicon layer. Therefore, Liu ('078) in view of Szwejkowski ('499) does disclose, teach or suggest a process where an amorphous carbon hard mask with a resist stack that includes at least one ARC over the hard mask is patterned and residual resist material that remains after a resist layer is used as an etching mask is removed when exposed to a hydroxide/peroxide solution, while leaving underlying layers on the substrate.

21. Applicant then argues that while Chen ('435) does teach the use of solutions of ammonium hydroxide and peroxide this reference fails to cure the deficiency of Liu ('078) and/or Szwejkowski ('499). However, Examiner maintains that Liu ('078) in view of Szwejkowski does teach the use of a resist stack and the removal of residual resist; moreover Liu in view of Szwejkowski does contemplate a process where the etching rate of resist is greater than the etch rate of the hard mask; therefore, the rejection of claims 4 and 16; the rejection of claims 5-9; and the rejection of claims 24-25 and 28-34 over Liu ('078) and Szwejkowski ('499) in view of Chen ('435) is proper.

22. Applicant argues that while Fang ('338) does show that the use of sulfuric acid and citric acid solutions are known in the art as cleaning solutions the reference fails to cure the deficiency of Liu ('078) and/or Szwejkowski ('499). However, Examiner maintains that Liu ('078) in view of Szwejkowski does teach the use of a resist stack and the removal of residual resist; therefore, the rejection of claims 10-12 and 26-27 over Liu ('078) and Szwejkowski ('499) in view of Fang ('338) is proper.

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23. Applicant argues that while Tsai ('132) teaches that dry development is known in the art the reference fails to deficiency of Liu ('078) and/or Szwejkowski ('499). However, Examiner maintains that Liu ('078) in view of Szwejkowski does teach the use of a resist stack and the removal of residual resist; therefore, the rejection of claim 22 over Liu ('078) and Szwejkowski ('499) in view of Tsai ('132) is proper.

24. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Conclusion

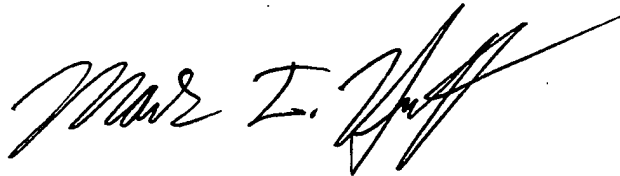
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Caleen O. Sullivan whose telephone number is 571-272-6569. The examiner can normally be reached Monday-Friday, 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/COS/, 08/09/07.



MARK E. HOFF
SUPERVISOR, PATENT EXAMINER
TECHNOLOGY CENTER 1700



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Substitute for form 1449A/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)	Complete if Known	
	Application Number	11/494,056
	Filing Date	July 27, 2006
	First Named Inventor	Shea, Kevin
	Group Art Unit	1756
	Examiner Name	Sullivan, Caleen
Sheet 1 of 1		Attorney Docket No: 303.867US3

US PATENT DOCUMENTS				
Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document	Filing Date If Appropriate
/CS/	US-20010051440	12/13/2001	Torek, Kevin J., et al.	06/29/1999
/CS/	US-20030008513	01/09/2003	Howard, Bradley J.	12/13/2001
/CS/	US-20030222241	12/04/2003	Torek, Kevin J., et al.	01/09/2003
/CS/	US-20040101784	05/27/2004	Howard, Bradley J.	11/06/2003
/CS/	US-20050026435A1	02/03/2005	Chen, G., et al.	08/02/2004
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/CS/	US-5,039,349	08/13/1991	Schoeppel, J. F.	05/18/1990
/CS/	US-5,783,495	07/21/1998	Li, L., et al.	06/05/1996
/CS/	US-5,855,811	01/05/1999	Grieger, E. K., et al.	10/03/1996
/CS/	US-5,990,019	11/23/1999	Torek, Kevin, et al.	11/10/1997
/CS/	US-6,235,145	05/22/2001	Li, Li, et al.	07/20/1998
/CS/	US-6,350,706	02/26/2002	Howard, Bradley J.	09/03/1998
/CS/	US-6,453,914	09/24/2002	Torek, Kevin J., et al.	06/29/1999
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FOREIGN PATENT DOCUMENTS				
Examiner Initials *	Foreign Document No	Publication Date	Name of Patentee or Applicant of cited Document	T ²

OTHER DOCUMENTS -- NON PATENT LITERATURE DOCUMENTS			
Examiner Initials *	Cite No ¹	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-Issue number(s), publisher, city and/or country where published.	T ¹
/CS/		WOLF, S., Silicon Processing for the VLSI Era, (1), Process Technology, (1986), 514-517 and 551-552	

EXAMINER /Caleen Sullivan/ (08/09/2007)

DATE CONSIDERED



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/494,056	07/27/2006	Kevin Shea	303.867US3	8891

21186 7590 05/16/2007
SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
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MINNEAPOLIS, MN 55402

EXAMINER

SULLIVAN, CALEEN O

ART UNIT	PAPER NUMBER
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1756

MAIL DATE	DELIVERY MODE
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05/16/2007

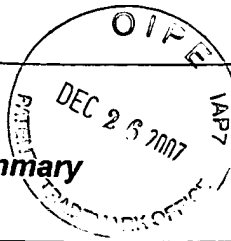
PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.



Office Action Summary



Application No.

11/494,056

Applicant(s)

SHEA ET AL.

Examiner

Caleen O. Sullivan

Art Unit

1756

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 July 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-34 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 July 2006 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

Drawings

1. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(4) because the resist layer in Figure 1A has been misnumbered with reference character “119” instead of reference character “118” as designated in the specification. (See, page 4). Also the resist stack in Figure 1A has been misnumbered with reference character “101” instead of reference character “100” as designated in the specification. (See, page 4). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

2. The use of the trademark Aleg® 820 has been noted in this application. It should be capitalized wherever it appears and be accompanied by the generic terminology. In the specification on pages 8, 10 and 13 the trademark Aleg® 820 is used but is not accompanied by the required generic terminology. Appropriate correction is required.

Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner, which might adversely affect their validity as trademarks.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 3-12 and 15-16 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contain subject matter, which was not described in the specification. In the aforementioned claims applicant includes limitations specifying “concentration ratios” for the “surface treating solutions” used in the process of removing residual photoresist; however, applicant has failed to describe in the specification if these “concentration ratios” are volume, weight, or mole ratios. For the purpose of examination, Examiner has considered the “concentration ratios” to be volume ratios in the rejections that follow.

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-12, 14-16, 24-26 and 29 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 3-12 and 15-16 include the term “concentration ratio;” however, it is unclear as to whether the concentration ratio is a volume, a weight, or a mole ratio. For the purpose of examination, Examiner has considered the “concentration ratio” to be a volume ratio in the rejections that follow.

Claims 1, 5, 10, 24 and 26 include the phrase “... resist stack including at least one antireflective coating...selected from a dielectric antireflective coating and a bottom antireflective coating, ... ” which Examiner considers to be a claim that includes a Markush group written in

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improper format. "Alternative expressions are permitted if they present no uncertainty or ambiguity with respect to the question of scope or clarity of the claims. One acceptable form of alternative expression, which is commonly referred to as a Markush group, recites members as being "selected from the group consisting of A, B and C." See *Ex parte Markush*, 1925 C.D. 126 (Comm'r Pat. 1925). These claims should be amended to recite proper Markush Language.

Claims 2, 14, 25 and 29 contain the trademark/trade name Aleg®820. Where a trademark or trade name is used in a claim as a limitation to identify or describe a particular material or product, the claim does not comply with the requirements of 35 U.S.C. 112, second paragraph. See *Ex parte Simpson*, 218 USPQ 1020 (Bd. App. 1982). The claim scope is uncertain since the trademark or trade name cannot be used properly to identify any particular material or product. A trademark or trade name is used to identify a source of goods, and not the goods themselves. Thus, a trademark or trade name does not identify or describe the goods associated with the trademark or trade name. In the present case, the trademark/trade name is used to identify/describe Aleg®820 solution and, accordingly, the identification/description is indefinite.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

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1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

7. Claims 1-3, 13-21 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szejewski ('499).

Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch, as recited in claim 23, and then the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). This disclosure teaches the limitation of claims 13 and 19-20, where a carbon containing hard mask over a substrate with a resist is patterned, where the hard mask comprises carbon, and the carbon comprises amorphous carbon.

Liu ('078) also teaches that the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56- col. 6, 45; Fig.3A-3F). This teaching meets the limitation of claims 1, 18, where an amorphous carbon hard mask that includes a resist stack, which includes at least one ARC over the hard mask, which is selected from a dielectric anti-reflective coating (DARC) and a bottom anti-reflective coating (BARC), and a photoresist layer is over the at least one ARC, is patterned. Moreover, this disclosure meets the limitation of claim 21.

However, Liu ('078) fails to teach a process step where the surface of the substrate is treated with a solution to remove residual resist under conditions that are not damaging to the underlying layers. Szejewski ('499) discloses a method, which teaches such process steps.

Szwejkowski ('499) discloses a method to remove sidewall residues remaining after a polysilicon layer that has been masked with a photoresist layer is etched. The residues from the etch process are removed without undercutting the remaining polysilicon, using a solution of ammonium hydroxide and peroxide. (See, col.2, 26-39 and 57-col.3, 2). This disclosure teaches the limitation of claims 1-3 and 14-15 where the substrate is treated with a solution including an ammonium hydroxide and peroxide solution to remove residual resist under conditions that are not damaging to the underlying layers.

Szwejkowski ('499) discloses that the solution of aqueous hydrogen peroxide and ammonium hydroxide has a concentration ratio by volume of about 1 part hydroxide to 2 parts peroxide to 7 parts water, which is within the concentration ratio ranges recited in claims 3 and 15. (See, col. 3, 38-40). Szwejkowski ('499) further discloses that the solution is heated and maintained between about 50°C – about 70°C (See, col.3, 45-49), and the substrate is in the solution for about 5 seconds to about 15 minutes to remove the excess residue. (See, col.3, 50-57). These teachings fall within the time and temperature ranges, which are between about 2 to about 45 minutes and between about room temperature to about 70°C, recited in claims 3, and 15 for applying the surface treating solution such as an ammonium hydroxide and peroxide solution or a solution that is comprised of ammonium hydroxide and peroxide and other components to the substrate.

Although Liu ('078) in view of Szwejkowski ('499) fails to explicitly disclose the limitation of claim 17, where the etch rate of the resist is one-hundred times greater than the etch rate of the hard mask layer, Liu ('078) in view of Szwejkowski ('499) does disclose that the overlying patterned layer is removed using a surface treating solution while the underlying layers are left undamaged (col.2, 57-col.3, 2; 19-27). This disclosure in Szwejkowski ('499) would encompass such a difference in the etching rates of the upper resist layer to the lower hard mask layer.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) in view of the teachings of Szwejkowski ('499) because polysilicon and carbon are in the same chemical series; therefore, it is obvious the cleaning solution and process disclosed in Szwejkowski ('499), used on a polysilicon layer can be used on a carbon layer to remove photoresist residue, while leaving the underlying layers undamaged.

8. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) as applied to claims 1-3, 13-21 and 23 in paragraph 7 above, and further in view of Tsai ('132). Liu ('078) in view of Szwejkowski ('499) fails to disclose the limitation of claim 22 where the patterned resist layer is developed by a dry development process. However, Tsai ('132) discloses such a process.

Tsai ('132) discloses a process of patterning a dual resist layer that will be patterned and developed to form a semiconductor feature etching pattern. Tsai ('132) discloses that the process consists of depositing two photoresist layers on the semiconductor substrate. (See, col.6, 36-37). Tsai ('132) further discloses that the bottom image layer is a non-silicon containing organic material, and the upper resist layer is preferably a DUV resist formed of silicon containing organic material. (See, col.5, 57-col.6, 14). Tsai ('132) discloses the next step in the process, which is the exposure of the upper resist layer to radiation of 193 nm or 157 nm and the exposed portions are developed away using convention developer leaving the unexposed portions of the upper resist layer as a dry development mask. (See, col.6, 38- 47).

Tsai ('132) goes on to disclose that the next a dry development step is performed to develop the exposed portions of the lower resist layer to form a pattern that will be used to etch features into the underlying semiconductor substrate. (See, col.6, 48-57). This disclosure meets the limitation of claim 22.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szejewski ('499) in view of the teachings of Tsai ('132) because Tsai ('132) teaches that one can perform a dry development step of a resist layer that will be used to pattern underlying layers.

9. Claims 4 and 16, are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szejewski ('499) as applied to claims 1-3, 13-21 and 23 in paragraph 7 above, and further in view of Chen ('435).

Liu ('078) in view of Szejewski ('499) fails to disclose solutions of ammonium hydroxide and peroxide with a concentration ratio of about 100:3:2, $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$. Dilute solutions of ammonium hydroxide and hydrogen peroxide that are used as cleaning solutions, are disclosed in Chen ('435).

Chen ('435) discloses a method of cleaning or stripping photoresist from photomasks by using solutions of ammonium hydroxide and hydrogen peroxide. In one embodiment Chen ('435) discloses applying a very dilute solution of ammonium hydroxide and hydrogen peroxide, with concentration ratios of 1:2-10:200-1000 that can be simplified to a ratio of .5:1-5:100-500, at low temperatures to clean or strip photoresist from a photomask. (See, para. 0024). This disclosure meets the limitation of claims 4 and 16, where solutions of ammonium hydroxide and hydrogen peroxide that may also contain other components, have a concentration ratio of 100:3:2 (claims 4 and 16), $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szejewski ('499) in view of the teachings of Chen ('435) because Chen ('435) teaches that dilute solutions of ammonium hydroxide and

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hydrogen peroxide can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

10. Claims 5-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szejewski ('499) and further in view of Chen ('435).

Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch and the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). Liu ('078) also teaches that the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56-col. 6, 45; Fig.3A-3F).

The teachings in Liu ('078) meet the limitation of claim 5, where an amorphous carbon hard mask that includes a resist stack is patterned. Moreover, the teachings in Liu ('078) meet the limitations of claim 5, where the resist stack includes at least one ARC over the hard mask, which is selected from a dielectric anti-reflective coating (DARC) and a bottom anti-reflective coating (BARC), and a photoresist layer is over the at least one ARC.

However, Liu ('078) fails to teach a process step where the surface of the substrate is treated with a solution to remove residual resist under conditions that are not damaging to the underlying layers. Szejewski ('499) discloses a method, which teaches such process steps.

Szejewski ('499) discloses a method to remove sidewall residues remaining after a polysilicon layer that has been masked with a photoresist layer is etched. The residues from the etch

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process are removed without undercutting the remaining polysilicon, using a solution of ammonium hydroxide and peroxide. (See, col.2, 26-39 and 57-col.3, 2). This disclosure teaches the limitations of claim 5, where the substrate is treated with a solution including an ammonium hydroxide and peroxide solution to remove residual resist under conditions that is not damaging to the underlying layers.

Szwejkowski ('499) discloses that the solution of aqueous hydrogen peroxide and ammonium hydroxide is heated and maintained between about 50°C – about 70°C (See, col.3, 45-49), and the substrate is in the solution for about 5 seconds to about 15 minutes to remove the excess residue. (See, col.3, 50-57). These teachings overlap with the temperature recited in claim 5 and falls within the time ranges, which are between about 5-30 minutes, recited in claims 6-9 for applying the surface treating solution of ammonium hydroxide and peroxide to the substrate.

Still, Liu ('078) in view of Szwejkowski ('499) fails to disclose solutions of ammonium hydroxide and peroxide with a concentration ratio of about 100:3:2, H₂O: NH₄OH: H₂O₂. Dilute solutions of ammonium hydroxide and hydrogen peroxide, used as cleaning solutions, are disclosed in Chen ('435).

Chen ('435) discloses a method of cleaning or stripping photoresist from photomasks by using solutions of ammonium hydroxide and hydrogen peroxide. In one embodiment Chen ('435) discloses applying a very dilute solution of ammonium hydroxide and hydrogen peroxide, with concentration ratios of 1:2-10:200-1000 that can be simplified to a ratio of .5:1-5:100-500, at low temperatures to clean or strip photoresist from a photomask. (See, para. 0024). This disclosure meets the limitation of claim 5, where the surface treating solution of ammonium hydroxide and hydrogen peroxide has a concentration ratio of 100:3:2, H₂O: NH₄OH: H₂O₂.

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It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) in view of Szwejkowski ('499) and further in view of Chen ('435) because polysilicon and carbon are in the same chemical series; therefore, it is obvious the cleaning solution and process disclosed in Szwejkowski ('499), used on a polysilicon layer can be used on a carbon layer to remove photoresist residue, while leaving the underlying layers undamaged and Chen ('435) teaches that dilute solutions of ammonium hydroxide and hydrogen peroxide can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

11. Claims 10-12 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) and further in view of Fang ('338).

Liu ('078) and Szwejkowski ('499) are relied upon as discussed in the rejection of claims 1-3, 13-21 and 23 under 35 USC 103 (a) in paragraph 7 above.

Still, Liu ('078) in view of Szwejkowski ('499) fails to teach a process step where the surface of the substrate is treated with an aqueous solution of sulfuric acid and citric acid, or an sulfuric acid solution containing solution, to remove residual resist under conditions that are not damaging to the underlying layers. Moreover, Liu ('078) in view of Szwejkowski ('499) fails to disclose that the treatment solutions of sulfuric acid and citric acid, have a concentration ratio of 100:3:2 (claim 11) or 100:2:2 (claim12), $H_2O: H_2SO_4: C_6H_4O_7$. However, solutions comprised of sulfuric acid that include citric acid are disclosed in Fang ('338).

Fang ('338) teaches a method to deposit a cobalt containing capping layer. As part of this process there is a pre-clean step where the substrate is exposed to a complexing agent solution to remove oxides or other residues such as organic residues, resist, and other polymeric residues from previous fabrication processes. (See, para.0028). This pre-clean step is analogous to the step recited in claim 21, where the substrate is treated with a solution to remove residual resist without damaging

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the underlying layers. The complexing agent is a solution that consists of at least one acid, a pH adjusting agent and other additives including citric acid and other acids such as sulfuric acid. (See, para.0029).

One exemplary complexing agent solution disclosed in Fang ('338) is comprised of water, citric acid in a concentration ratio of .05M to about 1.0M, EDTA, sulfuric acid in a concentration of .05N to about 1.0N and TMAH or ammonium in a concentration to adjust the pH to a range from about 1.5 to 10. (See, para. 0030). This disclosure meets the limitation of claim 10 where surface treating step includes using an aqueous sulfuric acid and citric acid solution, and the limitation of claims 26-27 where the surface treating solution is a sulfuric acid containing solution and includes at least aqueous citric acid. Although Fang ('338) does not disclose the concentration ratio recited in claims 11-12, one of ordinary skill in the art would be able to determine the appropriate concentration ratio to achieve a solution that would remove residual resist without damaging the underlying layers.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) in view of Szejewski ('499) and further in view of Fang ('338), because Szejewski ('499) and Fang ('338) teach that one can remove residual resist from structures such as the one disclosed in Liu ('078) with the solutions they disclose to prepare the structure for further processing without damaging the underlying layers of the structure.

12. Claims 24-25 and 28-34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szejewski ('499) and further in view of Chen ('435). Liu ('078) and Szejewski ('499) are relied upon as discussed in the rejection of claims 1-3, 13-21 and 23.

Although Liu ('078) in view of Szejewski ('499) fails to explicitly disclose the limitation of claim 33, where the etch rate of the resist is five times greater than the etch rate of the hard mask,

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Liu ('078) in view of Szwejkowski ('499) does disclose that the overlying resist layer is removed using a surface treating solution while the underlying layers are left undamaged (col.2, 57-col.3, 2; 19-27).

This disclosure encompasses such a difference in etch rates between the resist layer and the hard mask layer. Moreover, this disclosure also meets the limitation of claim 34 where the etch rate of the resist is greater than the etch rate of the ARC layer.

Liu ('078) in view of Szwejkowski ('499) fails to disclose a step of surface treating using an ozone-containing solution that may include other components such as those recited in claim 25 and 29. Treatment solutions such as these are disclosed in Chen ('435).

Chen ('435) discloses other solutions, which can be used to clean or strip resist from a photomask. One solution is comprised of sulfuric acid and ozone (SOM). (See, para 0020). Another exemplary solution is comprised of sulfuric acid and hydrogen peroxide (SPM). (See, para. 0034). Chen ('435) also discloses the various solutions can be combined and applied to the structure to strip or remove photoresist. (See, para. 0034 and 0043).

The disclosures in Chen ('435) meet the limitation of claim 24 and 28, where the surface treating solution includes ozone and the limitation of claims 25 and 29, where the surface treating solution is comprised of ozone (SOM) and one of the solutions recited in claims 25 and 29, which can be, for example, a solution of aqueous sulfuric acid and hydrogen peroxide, referred to as SPM in Chen ('435) (See, para. 0020).

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szwejkowski ('499) in view of the teachings of Chen ('435) because Chen ('435) teaches that ozone-containing solutions that may include other components such as a solution of ammonium hydroxide and hydrogen peroxide can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

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Double Patenting

13. A rejection based on double patenting of the "same invention" type finds its support in the language of 35 U.S.C. 101, which states that "whoever invents or discovers any new and useful process ... may obtain a patent therefor ..." (Emphasis added). Thus, the term "same invention," in this context, means an invention drawn to identical subject matter. See *Miller v. Eagle Mfg. Co.*, 151 U.S. 186 (1894); *In re Ockert*, 245 F.2d 467, 114 USPQ 330 (CCPA 1957); and *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970).

A statutory type (35 U.S.C. 101) double patenting rejection can be overcome by canceling or amending the conflicting claims so they are no longer coextensive in scope. The filing of a terminal disclaimer cannot overcome a double patenting rejection based upon 35 U.S.C. 101.

Claims 1-12 and 24-27 are provisionally rejected under 35 U.S.C. 101 as claiming the same invention as that of claims 12-23 and 35-38 of copending Application No. 10/788,889 (US-2005/0191584). This is a provisional double patenting rejection since the conflicting claims have not in fact been patented.

14. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

22-23

Claims 13-16, 19-20 and ~~23-24~~ are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-11, 24-34 and 39-42 of

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copending Application No. 10/788,889 (US-2005/0191584). Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims of copending Application No. 10/788,889 (US-2005/0191584) are fully encompassed by the recitations of claims 13-16, 19-20 and 23-24 of the present application.

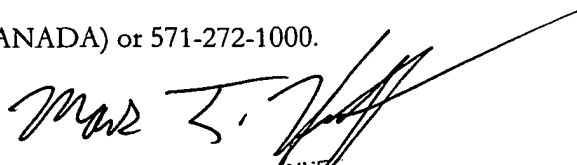
This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

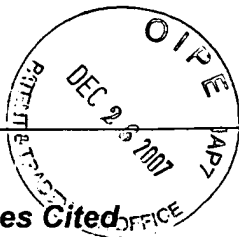
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Caleen O. Sullivan whose telephone number is 571-272-6569. The examiner can normally be reached Monday-Friday, 8:30am-5:00pm. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

COS, 05/07/2007


MARK E. HUFF
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700

**Notice of References Cited**

Application/Control No. 11/494,056	Applicant(s)/Patent Under Reexamination SHEA ET AL.	
Examiner Caleen O. Sullivan	Art Unit 1756	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,064,078	06-2006	Liu et al.	438/717
*	B	US-5,147,499	09-1992	Szwejkowski et al.	438/704
*	C	US-2005/0161338	07-2005	Fang et al.	205/176
*	D	US-6,720,132	04-2004	Tsai et al.	430/312
*	E	US-2005/0191584	09-2005	Shea et al.	430/329
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/494,056	07/27/2006	Kevin Shea	p 303.867US3	8891

21186	7590	10/31/2007
SCHWEGMAN, LUNDBERG & WOESSNER, P.A.		
P.O. BOX 2938		
MINNEAPOLIS, MN 55402		

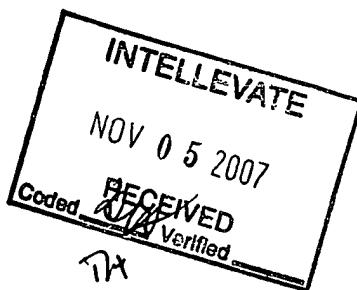
EXAMINER	
SULLIVAN, CALEEN O	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
10/31/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.



Schwegman Lundberg
& Woessner P.A.
NOV 05 2007

RECEIVED

Office Action Summary	Application No. 11/494,056	Applicant(s) SHEA ET AL.	
	Examiner Caleen O. Sullivan	Art Unit 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12 October 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5, 7, 10, 11, 13-15, 17, 19, 21 and 23-27 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5, 7, 10, 11, 13-15, 17, 19, 21 and 23-27 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 12 July 2007 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date <u>10/12/07</u> . | 6) <input type="checkbox"/> Other: _____ |

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DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114.

Applicant's submission filed on 10/12/07 has been entered.

2. Claim's 1-5, 7, 10-11, 13-15, 17, 19, 21 and 23-27 are presented.

3. Claim's 6, 8-9, 12, 16, 18, 20, 22 and 28-34 are cancelled.

Response to Amendment

4. Applicant's amendments to claims 1, 5, 10, 24 and 26 have overcome the rejection under 35 USC 112 for failure to write a Markush group in the proper format; therefore, Examiner has withdrawn this rejection.

5. Applicant's amendments to claims 3-5, 11, 15 has overcome the rejection under 35 USC 112 first paragraph for failure to define the concentration ratios as well as the rejection under 35 USC 112 second paragraph for indefiniteness; therefore, Examiner has withdrawn these rejections.

6. Applicant's amendments to claims 5, 7, 10, 17, 24 and 26 along with the cancellation of claims 6, 8-9, 12, 16, 18, 11 and 28-34 has failed to overcome the obvious double patenting rejection of claims 13-16, 19-20 and 23-24 over copending application No. 10/788,889 (US 2005/0191584). Until a terminal disclaimer is offered the rejection cannot be withdrawn. Therefore, Examiner maintains this rejection and the rejection is amended to reflect the cancellation of claims 6, 8-9, 12, 16, 18, 22 and 28-34 as well as the amendments to claims 5, 7, 10, 17, 24 and 26.

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7. Applicant's amendments to claims 1, 3-5, 7, 10-11, 15, 17, 21, 24 and 26, the cancellation of claims 6, 8-9, 12, 16, 18, 20, 22 and 28-34 and the arguments presented have failed to overcome the rejections presented in the previous Office Action. Therefore, Examiner maintains the rejections below with changes to reflect the cancellation of claims, which includes the withdrawal of moot rejections.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. Claims 1-3, 13-15, 17, 19, 21 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499).

Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch, as recited in claim

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23, and then the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). This disclosure teaches the limitation of claims 13 where a hard mask over a substrate with a resist is patterned and the limitation of claim 19 where the hard mask comprises carbon.

Liu ('078) also teaches that the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56- col. 6, 45; Fig.3A-3F). This teaching meets the limitation of claim 1 where an amorphous carbon hard mask that includes a resist stack, which includes at least one ARC over the hard mask, which is selected from the group consisting of a dielectric anti-reflective coating (DARC) and a bottom anti-reflective coating (BARC), and a photoresist layer is over the at least one ARC, is patterned. Moreover, this disclosure meets the limitation of claim 17 where the resist includes at least one antireflective coating and the limitation of claim 21.

However, Liu ('078) fails to teach a process step where the surface of the substrate is treated with a solution to remove residual resist under conditions that are not damaging to the underlying layers. Szejewski ('499) discloses a method, which teaches such process steps.

Szejewski ('499) discloses a method to remove sidewall residues remaining after a polysilicon layer that has been masked with a photoresist layer is etched. The residues from the etch process are removed without undercutting the remaining polysilicon, using a solution of ammonium hydroxide and peroxide. (See, col.2, 26-39 and 57-col.3, 2). This disclosure teaches the limitation of claims 1-3 and 14-15 where the substrate is treated with a solution including an ammonium hydroxide and peroxide solution to remove residual resist under conditions that are not damaging to the underlying layers.

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Szwejkowski ('499) discloses that the solution of aqueous hydrogen peroxide and ammonium hydroxide has a concentration ratio by volume of about 1 part hydroxide to 2 parts peroxide to 7 parts water, which is within the concentration ratio ranges recited in claims 3 and 15. (See, col. 3, 38-40). Szwejkowski ('499) further discloses that the solution is heated and maintained between about 50°C – about 70°C (See, col.3, 45-49), and the substrate is in the solution for about 5 seconds to about 15 minutes to remove the excess residue. (See, col.3, 50-57). These teachings fall within the time and temperature ranges, which are between about 2 to about 45 minutes and between about room temperature to about 70°C, recited in claims 3 and 15 for applying the surface treating solution such as an ammonium hydroxide and peroxide solution or a solution that is comprised of ammonium hydroxide and peroxide and other components to the substrate.

Although Liu ('078) in view of Szwejkowski ('499) fails to explicitly disclose the limitation of claim 17, where the etch rate of the resist is one-hundred times greater than the etch rate of the hard mask layer, Liu ('078) in view of Szwejkowski ('499) does disclose that the overlying patterned layer is removed using a surface treating solution while the underlying layers are left undamaged (col.2, 57-col.3, 2; 19-27). This disclosure in Szwejkowski ('499) would encompass such a difference in the etching rates of the upper resist layer to the lower hard mask layer.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) in view of the teachings of Szwejkowski ('499) because polysilicon and carbon are in the same chemical series; therefore, it is obvious the cleaning solution and process disclosed in Szwejkowski ('499), used on a polysilicon layer patterned using a resist layer as an etch mask can be used on a carbon layer to remove photoresist residue, while leaving the underlying layers undamaged.

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11. Claim 4-5 and 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) as applied to claims 1-3, 13-15, 17, 19, 21 and 23 in paragraph 10 above, and further in view of Chen ('435). The teachings of Liu ('078) in view of Szwejkowski ('499) meets also encompasses the temperature of the treating solution as recited in claim 5 and the time range of the surface treating as recited in claim 7. Still, Liu ('078) in view of Szwejkowski ('499) fails to disclose solutions of ammonium hydroxide and peroxide with a concentration ratio of about 100:3:2, H_2O : NH_4OH : H_2O_2 . Dilute solutions of ammonium hydroxide and hydrogen peroxide that are used as cleaning solutions, are disclosed in Chen ('435).

Chen ('435) discloses a method of cleaning or stripping photoresist from photomasks by using solutions of ammonium hydroxide and hydrogen peroxide. In one embodiment Chen ('435) discloses applying a very dilute solution of ammonium hydroxide and hydrogen peroxide, with concentration ratios of 1:2-10:200-1000 that can be simplified to a ratio of .5:1-5:100-500, at low temperatures to clean or strip photoresist from a photomask. (See, para. 0024). This disclosure meets the limitation of claim 4, where solutions of ammonium hydroxide and hydrogen peroxide that may also contain other components, have a concentration ratio of 100:3:2 (claim 4), H_2O : NH_4OH : H_2O_2 .

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szwejkowski ('499) in view of the teachings of Chen ('435) because Chen ('435) teaches that dilute solutions of ammonium hydroxide and hydrogen peroxide can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

12. Claims 10-11 and 26-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) as applied to claims 1-3, 13-15, 17, 19, 21 and 23 in paragraph

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11 above and further in view of Fang ('338). Still, Liu ('078) in view of Szwejkowski ('499) fails to teach a process step where the surface of the substrate is treated with an aqueous solution of sulfuric acid and citric acid, or an sulfuric acid solution containing solution, to remove residual resist under conditions that are not damaging to the underlying layers. Moreover, Liu ('078) in view of Szwejkowski ('499) fails to disclose that the treatment solutions of sulfuric acid and citric acid, have a concentration ratio of 100:3:2 (claim 11), $\text{H}_2\text{O}:\text{H}_2\text{SO}_4:\text{C}_6\text{H}_4\text{O}_7$. However, solutions comprised of sulfuric acid that include citric acid are disclosed in Fang ('338).

Fang ('338) teaches a method to deposit a cobalt containing capping layer. As part of this process there is a pre-clean step where the substrate is exposed to a complexing agent solution to remove oxides or other residues such as organic residues, resist, and other polymeric residues from previous fabrication processes. (See, para.0028). This pre-clean step is analogous to the step recited in claim 10, where the substrate is treated with a solution to remove residual resist without damaging the underlying layers. The complexing agent is a solution that consists of at least one acid, a pH adjusting agent and other additives including citric acid and other acids such as sulfuric acid. (See, para.0029).

One exemplary complexing agent solution disclosed in Fang ('338) is comprised of water, citric acid in a concentration ratio of .05M to about 1.0M, EDTA, sulfuric acid in a concentration of .05N to about 1.0N and TMAH or ammonium in a concentration to adjust the pH to a range from about 1.5 to 10. (See, para. 0030). This disclosure meets the limitation of claim 10 where surface treating step includes using an aqueous sulfuric acid and citric acid solution, and the limitation of claims 26-27 where the surface treating solution is a sulfuric acid containing solution and includes at least aqueous citric acid. Although Fang ('338) does not disclose the concentration ratio recited in

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claim 11, one of ordinary skill in the art would be able to determine the appropriate concentration ratio to achieve a solution that would remove residual resist without damaging the underlying layers.

It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the teachings of Liu ('078) in view of Szwejkowski ('499) and further in view of Fang ('338), because Szwejkowski ('499) and Fang ('338) teach that one can remove residual resist from structures such as the one disclosed in Liu ('078) with the solutions they disclose to prepare the structure for further processing without damaging the underlying layers of the structure.

13. Claims 24-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu ('078) in view of Szwejkowski ('499) and further in view of Chen ('435). Liu ('078) and Szwejkowski ('499) are relied upon as discussed in the rejection of claims 1-3, 13-15, 17, 19, 21 and 23 in paragraph 10 above. Still, Liu ('078) in view of Szwejkowski ('499) fails to disclose a step of surface treating using an ozone-containing solution that may include other components such as those recited in claim 25. Treatment solutions such as these are disclosed in Chen ('435).

Chen ('435) discloses other solutions, which can be used to clean or strip resist from a photomask. One solution is comprised of sulfuric acid and ozone (SOM). (See, para 0020). Another exemplary solution is comprised of sulfuric acid and hydrogen peroxide (SPM). (See, para. 0034). Chen ('435) also discloses the various solutions can be combined and applied to the structure to strip or remove photoresist. (See, para. 0034 and 0043).

The disclosures in Chen ('435) meet the limitation of claim 24, where the surface treating solution includes ozone and the limitation of claim 25, where the surface treating solution is comprised of ozone (SOM) and one of the solutions recited in claim 25, which can be, for example, a solution of aqueous sulfuric acid and hydrogen peroxide, referred to as SPM in Chen ('435) (See, para. 0020).

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It would have been obvious to one of ordinary skill in the art at the time of invention by applicant to modify the combination of Liu ('078) and Szwejkowski ('499) in view of the teachings of Chen ('435) because Chen ('435) teaches that ozone-containing solutions that may include other components such as a solution of ammonium hydroxide and hydrogen peroxide can be used to remove residual resist from a photomask and leave the underlying layers undamaged.

Double Patenting

14. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 13-15, 19 and 23 are provisionally rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-11, 24-34 and 39-42 of copending Application No. 10/788,889 (US-2005/0191584). Although the conflicting claims are not identical, they are not patentably distinct from each other because the claims of copending Application No. 10/788,889 (US-2005/0191584) are fully encompassed by the recitations of claims 13-15, 19 and 23 of the present application.

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This is a provisional obviousness-type double patenting rejection because the conflicting claims have not in fact been patented.

Response to Arguments

15. Applicant's arguments filed 10/12/07 have been fully considered but they are not persuasive.

16. Foremost Applicant argues that Liu ('078) fails to disclose the use of a resist stack of any kind; however Liu does disclose the use of a resist stack. Liu ('078) teaches a method of using amorphous carbon (APF) in the etching of a substrate. Liu ('078) discloses a structure that consists of a substrate on which an amorphous carbon layer and then a layer of photoresist are deposited. (See, col.5, 15-43; Fig. 2B). The features patterned into the photoresist layer are transferred to the amorphous carbon layer by a plasma etch and then the features patterned into the amorphous carbon layer are patterned into the substrate using the carbon layer as a hard mask. (See, col.5, 15-43). Liu ('078) also teaches that the structure disclosed may include a non-carbon based dielectric layer that is deposited over the amorphous carbon layer before the photoresist layer is deposited, which can also act as an antireflective coating (ARC). (See, col. 5, 56- col. 6, 45; Fig.3A-3F). These teachings in Liu do disclose the use of resist stack.

17. Applicant then argues Liu ('078) fails to suggest a problem with residual resist material remaining after the removal of photoresist, and that in the Szwejkowski ('499) reference there is no suggestion that the silicon oxide film removed is photoresist. Examiner did not rely on Liu ('078) as teaching the limitation that residual resist remained after the photoresist material was stripped. The limitation of removing residual resist was taught in Szwejkowski ('499). Although, Szwejkowski ('499) does not explicitly state the polymeric silicon oxide-containing residue on the polysilicon layer

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is resist, it is readily apparent that the residue includes resist material, which remains from the process where the resist layer is used as an etch mask for the underlying polysilicon layer.

The residue, which contains resist material, is then removed when the structure is exposed to the hydroxide/peroxide solution. Moreover, Applicant has assumed the etching step using the resist layer as a mask removes all the resist material that is used to pattern the underlying polysilicon layer. Therefore, Liu ('078) in view of Szwejkowski ('499) does disclose, teach or suggest a process where an amorphous carbon hard mask with a resist stack that includes at least one ARC over the hard mask is patterned and residual resist material that remains after a resist layer is used as an etching mask is removed when exposed to a hydroxide/peroxide solution, while leaving underlying layers on the substrate.

18. Applicant then argues that while Chen ('435) does teach the use of solutions of ammonium hydroxide and peroxide this reference fails to cure the deficiency of Liu ('078) and/or Szwejkowski ('499). However, Examiner maintains that Liu ('078) in view of Szwejkowski does teach the use of a resist stack and the removal of residual resist; moreover Liu ('078) in view of Szwejkowski ('499) does contemplate a process where the etching rate of resist is greater than the etch rate of the hard mask; therefore, the rejection of claims 4, 5 and 7 as well as the rejection of claim 24-25 over Liu ('078) and Szwejkowski ('499) in view of Chen ('435) is proper.

19. Applicant argues that while Fang ('338) does show that the use of sulfuric acid and citric acid solutions are known in the art as cleaning solutions the reference fails to cure the deficiency of Liu ('078) and/or Szwejkowski ('499). However, Examiner maintains that Liu ('078) in view of Szwejkowski ('499) does teach the use of a resist stack and the removal of residual resist; therefore, the rejection of claims 10-11 and 26-27 over Liu ('078) and Szwejkowski ('499) in view of Fang ('338) is proper.

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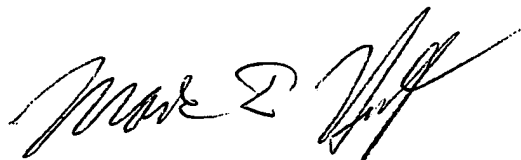
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Caleen O. Sullivan whose telephone number is 571-272-6569. The examiner can normally be reached Monday-Friday, 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 571-272-1385. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/COS/, 10/24/07.



MARK E. HUFF
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700

S/N 11/494,056

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Kevin Shea et al.

Examiner: Caleen O Sullivan

Serial No.: 11/494,056

Group Art Unit: 1756

Filed: July 27, 2006

Docket No.: 303.867US3

Title: SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND
SURFACE TREATMENT COMPOSITIONS USED THEREFOR

AMENDMENT AND RESPONSE UNDER 37 CFR § 1.111

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

This paper responds to the Office Action mailed on May 16, 2007. Please amend the
above-identified patent application as follows.

IN THE DRAWINGS

Corrected drawings are supplied herewith.

Enclosed is a Replacement Sheet showing the following amendment to Figure 1A.

The incorrect reference numbers 101 and 119 are replaced with the correct reference numbers 100 and 118, respectively.

IN THE SPECIFICATION

Please amend the specification as follows:

The paragraphs beginning at page 1, line 14 are amended as follows:

The importance of minimizing contamination during semiconductor fabrication processes has been recognized since the early days of the industry. Miniaturization is the process of crowding more semiconductive devices onto a smaller substrate area in order to achieve better device speed, lower energy usage, and better device portability, among others. New processing methods must often be developed to enable miniaturization to be realized. As semiconductor devices have become smaller and more complex, cleanliness requirements have become increasingly stringent, especially for devices with submicron critical dimensions, because the ability to reliably create multi-level metallization structures is increasingly vital. The importance of cleaning and conditioning submicron devices during the fabrication process is also emphasized because small-scale residues that may not have seriously affected the performance these devices previously, may now cause unacceptable yield loss.

Dry development processes are used in preparing patterned hard masks. The removal of photoresist material (hereinafter "resist") is challenging since the hard mask material is often amorphous carbon, and the resist is often a carbon-rich composition. During the dry development process, some dry-developed resist can become pooled-up on surfaces that need to be clear for subsequent processing. The pooled-up resist presents a challenge for the fabricator because it represents an unacceptably dirty wafer for further processing. A further challenge is to remove resist from the edges of a wafer, as the resist is often thicker (known as an "edge bead") near the edges due to its mode of being applied to the wafer. Consequently, as residues from the resist tend to ~~pooled-up~~ pool in some areas and as edge-bead resist tends to be present at the edge of the wafer, the total removal of photoresist material may become difficult.

Unremoved resist can be mobilized during subsequent processing that creates further undesirable results during the etch process that uses the hard mask.

The paragraph beginning at page 6, line 27 is amended as follows:

Although the semiconductive substrate 110 is depicted as BPSG in the above example, other substrates are also used in this disclosure. In an embodiment, a ~~phosephosilicate~~ phosphosilicate glass ("PSG") substrate is used. In an embodiment, a borophosphosilicate glass ("BSG") substrate is used. In an embodiment, a silica substrate is used. In an embodiment, an alumina substrate is used. In an embodiment, a thoria substrate is used. In an embodiment, a ceria substrate is used. In an embodiment, a nitride substrate is used. In an embodiment, the nitride substrate is silicon nitride, Si_xN_y . In this nitride substrate, x is equal to about 3 and y is equal to about 4.

The paragraph beginning at page 8, line 13 is amended as follows:

In an embodiment, a second surface treating composition is added to the aqueous ammonium hydroxide and hydrogen peroxide solution. In an embodiment, the second surface treating composition includes aqueous sulfuric acid and citric acid solution. In an embodiment, the second surface treating composition includes aqueous sulfuric acid and hydrogen peroxide solution. In an embodiment, the second surface treating composition includes Aleg® 820 solution, a trademark of, and manufactured by Mallinckrodt Baker, Inc. of St. Louis, Missouri. In an embodiment, the second surface treating composition includes ozone with dilute ammonium hydroxide in a ratio of about 1000:1:100 $\text{H}_2\text{O}:\text{O}_3:\text{NH}_4\text{OH}$ to about 1000:2:100.

The paragraph beginning at page 10, line 14 is amended as follows:

In another example, a plurality proportion of aqueous ammonium hydroxide and hydrogen peroxide solution is provided in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 100:3:2. A first minority proportion of aqueous ammonium hydroxide and hydrogen peroxide solution is provided in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 5:1:1. A second minority proportion of at least one solution selected from aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, Aleg® 820 solution, a trademark of, and manufactured by Mallinckrodt Baker, Inc. of St. Louis, Missouri, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride. An amorphous carbon hard

mask is dry developed over a semiconductive substrate. A surface treating process is undertaken with the given solution mixture.

The paragraph beginning at page 13, line 9 is amended as follows:

In an embodiment, a second surface treating composition is added to the aqueous ammonium hydroxide and hydrogen peroxide solution. In an embodiment, the second surface treating composition includes aqueous sulfuric acid and citric acid solution. In an embodiment, the second surface treating composition includes aqueous sulfuric acid and hydrogen peroxide solution. In an embodiment, the second surface treating composition includes Aleg® 820 solution, a trademark of, and manufactured by Mallinckrodt Baker, Inc. of St. Louis, Missouri. In an embodiment, the second surface treating composition includes ozone with dilute ammonium hydroxide. In an embodiment, the second surface treating composition includes, and ozone with dilute hydrogen fluoride; often referred to as "fluorozone".

IN THE CLAIMS

Please amend the claims as follows:

1. (Currently Amended) A process comprising:
patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:
at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating;
and
a photo resist layer disposed over the at least one antireflective coating; and
surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate.
2. (Currently Amended) The process of claim 1, wherein surface treating includes rinsing the photo resist with a solution selected from aqueous ammonium hydroxide and hydrogen peroxide solution, aqueous sulfuric acid and citric acid solution, aqueous sulfuric acid and hydrogen peroxide solution, ~~Aleg-820 solution~~, ozone with dilute ammonium hydroxide, ozone with dilute hydrogen fluoride, and combinations thereof.
3. (Original) The process of claim 1, wherein surface treating includes using a water, ammonium hydroxide and hydrogen peroxide solution in an $H_2O:NH_4OH:H_2O_2$ concentration ratio from about 5:1:1 to about 100:3:2, a time range from about 2 minutes to about 45 minutes, and a temperature range from about room temperature to about 70° C.
4. (Original) The process of claim 1, wherein surface treating includes using a water, ammonium hydroxide and hydrogen peroxide solution in an $H_2O:NH_4OH:H_2O_2$ concentration ratio of about 100:3:2, a time range from about 10 minutes to about 20 minutes, and a temperature range from about 30° C to about 60° C.

-
5. (Currently Amended) A process comprising:
patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:
at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating;
and
a photo resist layer disposed over the at least one antireflective coating; and
surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, wherein surface treating includes using a water, ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 100:3:2, and a temperature of about 55° C.
6. (Original) The process of claim 5, wherein surface treating includes a surface treating time of at least about 5 minutes.
7. (Original) The process of claim 5, wherein surface treating includes a surface treating time of greater than about 5 minutes to about 10 minutes.
8. (Original) The process of claim 5, wherein surface treating includes a surface treating time of greater than about 10 minutes to about 20 minutes.
9. (Original) The process of claim 5, wherein surface treating includes a surface treating time of greater than about 20 minutes to about 30 minutes.
10. (Currently Amended) A process comprising:
patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:

at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating;
and

a photo resist layer disposed over the at least one antireflective coating; and
surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, wherein surface treating includes using an aqueous sulfuric acid and citric acid solution for a time of about 10 minutes, and a temperature of about 55° C.

11. (Original) The process of claim 10, wherein surface treating includes using a water, sulfuric acid and citric acid solution in an $H_2O:H_2SO_4:C_6H_4O_7$ concentration ratio of about 100:3:2.

12. (Original) The process of claim 10, wherein surface treating includes using a water, sulfuric acid and citric acid solution in an $H_2O:H_2SO_4:C_6H_4O_7$ concentration ratio of about 100:2:2.

13. (Original) A process comprising:
patterning a hard mask with a patterned photo resist layer; and
surface treating the substrate to remove residual photo resist at a first etch rate under conditions that are selective to etch the hard mask at a second etch rate that is lower than the photo resist first etch rate.

14. (Currently Amended) The process of claim 13, wherein surface treating includes rinsing the photo resist with a solution selected from a mixture of at least one of aqueous ammonium hydroxide and hydrogen peroxide solution, aqueous sulfuric acid and citric acid solution, aqueous sulfuric acid and hydrogen peroxide solution, ~~Aleg 820 solution~~, ozone with dilute ammonium hydroxide, ozone with dilute hydrogen fluoride, fluorozone and piranha solution.

-
15. (Original) The process of claim 14, wherein surface treating includes using a water, ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio from about 5:1:1 to about 100:3:2, a time range from about 2 minutes to about 45 minutes, and a temperature range from about room temperature to about 70° C.
16. (Original) The process of claim 14, wherein surface treating includes using a water, ammonium hydroxide and hydrogen peroxide solution in an $\text{H}_2\text{O}:\text{NH}_4\text{OH}:\text{H}_2\text{O}_2$ concentration ratio of about 100:3:2, a time range from about 10 minutes to about 20 minutes, and a temperature range from about 30° C to about 60° C.
17. (Original) The process of claim 13, wherein the first etch rate is at least about a hundred times faster than the second etch rate.
18. (Original) The process of claim 13, wherein the photo resist includes at least one antireflective coating selected from a dielectric antireflective coating and a bottom antireflective coating.
19. (Original) The process of claim 13, wherein the hard mask comprises carbon.
20. (Original) The process of claim 19, wherein the hard mask formed of carbon comprises amorphous carbon.
21. (Original) The process of claim 18, wherein the dielectric antireflective coating is formed above the hard mask, the bottom antireflective coating is formed above the antireflective coating, and the photo resist layer is formed above the bottom antireflective coating.
22. (Original) The process of claim 13, wherein the patterned photo resist layer is developed by a dry development process.

23. (Original) The process of claim 13, wherein the patterned photo resist layer is used as one of a plasma etch, a wet chemical etch and a dry develop mask for patterning the hard mask.

24. (Currently Amended) A process comprising:

patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:

at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating; and

a photoresist layer disposed over the at least one antireflective coating; and surface treating the substrate to remove residual resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, wherein surface treating includes using an ozone-containing solution.

25. (Currently Amended) The process of claim 24, wherein surface treating includes using the ozone-containing solution and at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ~~Aleg-820 solution~~, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride.

26. (Currently Amended) A process comprising:

patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:

at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating; and

a photoresist layer disposed over the at least one antireflective coating; and surface treating the substrate to remove residual resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, wherein surface treating includes using a sulfuric acid-containing solution.

27. (Original) The process of claim 26, wherein surface treating includes using the sulfuric acid-containing solution and at least one of aqueous citric acid, aqueous oxaloacetic acid, aqueous acetic acid, and an acetic functional group aqueous acid.
28. (Original) A process comprising:
patterning a hard mask over a substrate with a photo resist; and
surface treating the substrate to remove residual resist at a first etch rate under conditions that are selective to etching the hard mask at a second etch rate and the substrate at a third etch rate, wherein surface treating includes using an ozone-containing solution.
29. (Currently Amended) The process of claim 28, wherein surface treating includes using the ozone-containing solution and at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ~~Aleg-820 solution~~, ozone with dilute ammonium hydroxide, fluorozone, a sulfuric acid-containing solution, piranha solution and ozone with dilute hydrogen fluoride.
30. (Original) The process of claim 28, wherein the hard mask is formed of a carbon material deposited under conditions to have a low etch rate by the surface treatment.
31. (Original) The process of claim 30, wherein the carbon comprises an amorphous carbon material.
32. (Currently Amended) The process of claim 28, wherein the photo resist layer includes at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating, and the photo resist layer is disposed over the at least one antireflective coating.
33. (Original) The process of claim 28, wherein the first etch rate is at least about five times greater than the second and third etch rate.

34. (Original) The process of claim 32, wherein the first etch rate is greater than an etch rate of the at least one antireflective coating.

REMARKS

This paper responds to the Office Action mailed on May 16, 2007.

Claims 1, 2, 5, 10, 14, 24-26, 29 and 32 are amended, no claims are canceled, and no claims are added. As a result, claims 1-34 are now pending in this application.

Objections to the Specification

The specification was objected to because of the use of the trademark Aleg® 820. The specification is amended herein to correct these, and other, inadvertent errors. No new matter has been added by these specification changes. Applicant thanks the Examiner for finding these errors, and making such a thorough review of the application.

Information Disclosure Statement

Applicant submitted an Information Disclosure Statement and a 1449 Form on June 18, 2007. Applicant respectfully requests that an initialed copy of the 1449 Form be returned to Applicant's Representatives to indicate that the cited references have been considered by the Examiner.

§112 Rejection of the Claims

Claims 3-12 and 15-16 were rejected under 35 U.S.C. § 112, first paragraph, as lacking adequate description or enablement. In particular, the use of concentration ratios is stated to not be clear as to volume, weight or mole ratios. Applicant respectfully traverses this rejection.

Applicant respectfully submits that the specification does indicate clearly the type of concentration ratio used, at least on pages 9, 10, and 12, where it states that the "presence by volume" of an aqueous solution is the ratio indicated. Thus, Applicant agrees with the Examiner's assumption on page 3 that volume ratios are indicated by the specification. Applicant respectfully submits that the description is adequate for one of ordinary skill in the art to practice the invention without undue experimentation.

Applicant respectfully submits that the outstanding Office Action has therefore failed to establish a *prima facie* case of lack of written description under § 112, since the Office does not demonstrate the needed elements, including that (1) the application does not reasonably describe or convey the concepts (2) to one of ordinary skill in the art (3) at the time of filing the patent application (4) of the claimed invention. Since the information requested by the Examiner is disclosed in the Application as-filed, Applicant respectfully submits that the specification is proper under 35 USC § 112, first paragraph, and requests that this rejection under the first paragraph of 35 U.S.C. § 112 be reconsidered and withdrawn.

Claims 1-12, 14-16, 24-26 and 29 were rejected under 35 U.S.C. § 112, second paragraph, for indefiniteness. In particular claims 3-12 and 15-16 were rejected for using the phrase “concentration ratio”, which is related to the 35 U.S.C. § 112, first paragraph, rejection discussed immediately above. This rejection is respectfully traversed. Applicant submits that the same changes and response given immediately above with reference to the 35 U.S.C. § 112, first paragraph rejection adequately address this rejection as well, and therefore requests that this rejection under the second paragraph of 35 U.S.C. § 112 also be reconsidered and withdrawn.

Claims 1, 3, 10, 24 and 26 were rejected for including an improper Markush group. Applicant has amended the claims to recite proper Markush language, not for reasons related to patentability, and requests this rejection be withdrawn.

§103 Rejection of the Claims

Claims 1-3, 13-21 and 23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. (U.S. 7,064,078) in view of Szwejkowski et al. (U.S. 5,147,499). Applicant respectfully traverses this rejection.

The cited reference of Liu is seen as describing a process that uses a first photoresist mask 106 to etch a first pattern 108 in an amorphous carbon hard mask 104, then removing the first photoresist, such that there is no photoresist remains on the pattern (Figure 2C). Then a second photoresist mask 110 is formed and used to etch a second different pattern 112 on the hard mask 114, and then the second photoresist is removed leaving no photoresist on the

patterned hard mask 104. At this point, Liu's process etches the combined pattern of the first and the second photoresist layers, each of which has been used to etch the hard mask 104, into the substrate 102 below the hard mask.

Applicant is unable to find any indication in the cited reference of Liu of the use of a resist stack of any type, or of even a suggestion of a problem with residual photoresist material remaining after the removal of the photoresist. This is not surprising since removing a simple resist layer from hard masks is not the same thing as what is addressed in the present application. Rather, the instant application describes activities which operate to remove photoresist from a *dielectric antireflective coating and a bottom antireflective coating* at the same time as the hard mask and substrate, as shown in figures 1A-1D and discussed on page 5, lines 17-26. Applicant therefore respectfully submits that the cited reference discloses a different arrangement of materials, and consequently a different problem. Thus, Liu is an inappropriate reference.

The cited reference of Szwejkowski describes a method of removing a silicon and oxide containing sidewall material 26, which is a polymer inadvertently formed during the anisotropic etch, and over etch, which formed the polysilicon 20 into a polysilicon line 28. The sidewall material 26 is formed of silicon and oxides, and is nowhere suggested to be a residual portion of the photoresist 32, as discussed at least at column 1, lines 32-42, and column 2, lines 4-11. The sidewall material 26 is stated to conventionally be removed by HF, being formed of silicon and oxides (see col. 2, lines 29-38; col. 3, lines 5-11). Szwejkowski also notes that the sidewall material is "not purely polysilicon" (see col. 3, line 8) and is not a photoresist or even a pure organic material. It is clearly stated to be a "polymerized silicon/oxide containing material" and from anisotropic etching of polysilicon and removable with HF, a material well known NOT to remove photoresist residues.

Applicant can find nothing in Szwejkowski suggesting removing a photoresist, or that the silicon and oxide film 26 is somehow related to residual photoresist. The suggested methods, including HF etching, are directed towards dielectric etching. Thus, the cited reference has a different arrangement of materials, does not suggest the use of a resist stack, and the suggested method would have no effect on a residual photoresist region, as the instant application discloses. The suggested method is inoperable for the problem addressed by the present application, and thus the Szwejkowski reference is inappropriate and should be withdrawn.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including: at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating; and a photo resist layer disposed over the at least one antireflective coating; and surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate...*”, as recited in independent claim 1, and amended herein, from which claims 2 and 3 depend. Since neither cited reference containing any suggestion of a photoresist stack, any residual resist, or of removing the residue from the resist stack, then the suggested combination does not contain the above noted features.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*surface treating the substrate to remove residual photo resist at a first etch rate under conditions that are selective to etch the hard mask at a second etch rate that is lower than the photo resist first etch rate...*”, as recited in independent claim 13, from which claims 14-21 and 23 depend. Since neither cited reference containing any suggestion of any form of residual resist, or of removing a residue, the suggested combination does not contain the above noted features.

The dependent claims are held to be patentable at least as depending from patentable base claims as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the failure of the references to describe or suggest at least removing residual photoresist, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claim 22 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. in view of Szwejkowski et al. as applied to claims 1-3, 13-21 and 23 in paragraph 7 of the office action, and further in view of Tsai et al. (U.S. 6,720,132). Applicant respectfully traverses this rejection.

The cited references of Liu and Szwejkowski have features discussed above with reference to the previous rejection. The cited reference of Tsai is used by the Office to show that

dry development of resist is known. However, Tsai is not seen as curing the above noted failure of the suggested combination to describe or suggest at least any form of residual resist problem, or of removing any type of residue.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*surface treating the substrate to remove residual photo resist at a first etch rate under conditions that are selective to etch the hard mask at a second etch rate that is lower than the photo resist first etch rate...*”, as recited in independent claim 13, from which claim 22 depends. Since none of the cited references contain any suggestion of the presence of residual resist, or of removing a residue, the suggested combination can not suggest the above noted features.

The dependent claim is held to be patentable at least as depending from patentable base claims as shown above. See M.P.E.P. § 2143.03. In view of the failure of the references to describe or suggest at least removing residual photoresist, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 4 and 16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. in view of Szejewski et al. as applied to claims 1-3, 13-21 and 23 in paragraph 7 of the office action, and further in view of Chen et al. (U.S. Publication 2005/0026435). Applicant respectfully traverses this rejection.

The cited references of Liu and Szejewski have features discussed above with reference to the previous rejections. The cited reference of Chan is used by the Office to show that solutions of ammonium hydroxide and peroxide are known in the art to be used as cleaning solutions. However, Chen is not seen as curing the failure of the suggested combination to suggest resist residues or removing resist residues, and thus the suggested combination fails to provide proper motivation to combine.

Further, Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including: at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating; and a photo resist layer*”

disposed over the at least one antireflective coating; and surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate...", as recited in independent claim 1, as amended herein, from which claim 4 depends. Since the cited reference do not suggest containing a photoresist stack containing an antireflection layer, or a residual resist, or removing the residue from the resist stack, then the suggested combination does not contain the above noted features.

Similar reasoning pertains to the rejection of claim 16. Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of "*...surface treating the substrate to remove residual photo resist at a first etch rate under conditions that are selective to etch the hard mask at a second etch rate that is lower than the photo resist first etch rate...*", as recited in independent claim 13, from which claim 16 depends. None of the cited references contain any suggestion of the presence of residual resist, or of removing a residue, and thus the combination can not suggest the above noted features.

The dependent claims are held to be patentable at least as depending from patentable base claims as shown above. See M.P.E.P. § 2143.03. In view of the failure of the references to describe or suggest at least removing residual photoresist, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 5-9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. in view of Szejewski et al. and further in view of Chen et al. Applicant respectfully traverses this rejection. The references have all been discussed above and do not contain any suggestion of a residual photoresist or removing the residual photoresist.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of "*...the resist stack including: at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating; and a photo resist layer disposed over the at least one antireflective coating; and surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, wherein surface treating includes using a water, ammonium hydroxide and hydrogen peroxide solution in an H₂O:NH₄OH:H₂O₂ concentration*

ratio of about 100:3:2, and a temperature of about 55° C...", as recited in independent claim 5, as amended herein, from which claims 6-9 depend. The reasons are similar to those given above, including that none of the cited references suggest the presence of residual resist, or of removing a residue.

The dependent claims are held to be patentable at least as depending from patentable base claims as shown above. See M.P.E.P. § 2143.03. In view of the failure of the reference to describe or suggest at least removing residual photoresist, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claims 10-12 and 26-27 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. in view of Szwejkowski et al. and further in view of Fang et al. (U.S. Publication 2005/0161338). Applicant respectfully traverses this rejection.

The cited references of Liu and Szwejkowski have features discussed above with reference to the previous rejections. The cited reference of Fang is used by the Office to show that solutions of sulfuric and citric acids are known in the art to be used as cleaning solutions for cobalt layers, although not at the recited concentrations of the present claims. Fang is not seen as curing the failure of the suggested combination to suggest resist residues or removing resist residues, and thus the suggested combination still fails to provide proper motivation to combine.

Further, Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of "*...patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including: at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating; and a photo resist layer disposed over the at least one antireflective coating; and surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate...*", as recited in independent claim 10, as amended herein, with similar limitation found in claim 26, as amended herein, from which the other claims depend. Since the cited reference do not suggest containing a photoresist stack containing an antireflection layer, or a residual resist, or of removing the residue from the resist stack, then the suggested combination does not contain the above noted features.

Claims 24-25 and 28-34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu et al. in view of Szwejkowski et al. and further in view of Chen et al. Applicant respectfully traverses this rejection. These references have all been discussed above and do not contain any suggestion of a residual photoresist or removing the residual photoresist.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*the resist stack including: at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating; and a photoresist layer disposed over the at least one antireflective coating; and surface treating the substrate to remove residual resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate...*”, as recited in independent claim 24, as amended herein, from which claim 25 depends. The reasons are similar to those given above, including that none of the cited references suggest the presence of residual resist, or of removing a residue.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*surface treating the substrate to remove residual resist at a first etch rate under conditions that are selective to etching the hard mask at a second etch rate and the substrate at a third etch rate, wherein surface treating includes using an ozone-containing solution...*”, as recited in independent claim 28, from which claims 29-34 depend. While the suggested combination does discuss striping resist layers overlying the hard mask, there is no suggestion of removing a residual layer that remains after the resist layer is removed.

The dependent claims are held to be patentable at least as depending from patentable base claims as shown above. See M.P.E.P. § 2143.03. In view of the failure of the reference to describe or suggest at least removing residual photoresist, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Provisional Double Patenting Rejections

Claims 1-12 and 24-27 were provisionally rejected on double patenting under 35 U.S.C. 101 as claiming the same invention over claims 12-23 and 35-38 of co-pending Application No. 10/788,889. Applicant submits that claims 12-23 and 35-38 of co-pending Application No.

10/788,889 have been cancelled in a recent response in that case. As a result of the action in the co-pending Application No. 10/788,889, claims 1-12 and 24-27, as amended herein, no longer comprise double patenting over the cited application. Applicant requests this rejection be withdrawn.

Claims 13-16, 19-20 and 22-23 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting over claims 1-11, 24-34 and 39-42 co-pending Application No. 10/788,889. Applicant does not admit that claims 1-12 and 24-27, as amended herein, comprise double patenting over the cited application, but Applicant will consider filing a terminal disclaimer when the present claims are otherwise held to be allowable.

RESERVATION OF RIGHTS

In the interest of clarity and brevity, Applicant may not have addressed every assertion made in the Office Action. Applicant's silence regarding any such assertion does not constitute any admission or acquiescence. Applicant reserves all rights not exercised in connection with this response, such as the right to challenge or rebut any tacit or explicit characterization of any reference or of any of the present claims, the right to challenge or rebut any asserted factual or legal basis of any of the rejections, the right to swear behind any cited reference such as provided under 37 C.F.R. § 1.131 or otherwise, or the right to assert co-ownership of any cited reference. Applicant does not admit that any of the cited references or any other references of record are relevant to the present claims, or that they constitute prior art. To the extent that any rejection or assertion is based upon the Examiner's personal knowledge, rather than any objective evidence of record as manifested by a cited prior art reference, Applicant timely objects to such reliance on Official Notice, and reserves all rights to request that the Examiner provide a reference or affidavit in support of such assertion, as required by MPEP § 2144.03.

CONCLUSION

Applicant respectfully submits that the claims are in condition for allowance, and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney David Suhl at (508) 865-8211, or the undersigned at (210) 308-5677 to facilitate prosecution of this application. If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

KEVIN SHEA ET AL.

By their Representatives,

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Date July 12, 2007

By /

Mark V. Muller

Mark V. Muller

Reg. No. 37,509

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being filed using the USPTO's electronic filing system EFS-Web, and is addressed to: Mail Stop Amendment, Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 12 day of July 2007.

KATE GANNON

Name

Kate Gannon

Signature



In re Patent Application of: Kevin Shea et al.

Title: SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND
SURFACE TREATMENT COMPOSITIONS USED THEREFOR

Serial No.: 11/494,056

Receipt is hereby acknowledged for the following in the United States Patent and RCE
Trademark Office:

CONTENTS: REQUEST FOR CONTINUED EXAMINATION (RCE) Transmittal (1 pg);
Amendment Under 37 CFR § 1.116 (16 pages); Information Disclosure Statement (2 pages),
Form 1449 (1 page) and 14 Copies of cited references; Please charge the Deposit Account
19-0743 in the amount of \$810.00 to pay the RCE filing fee; and return postcard

Mailed: October 10, 2007
MVM/ajm

Docket No.: 303.867US3
Due Date: October 17, 2007



REQUEST FOR CONTINUED EXAMINATION (RCE) TRANSMITTAL Subsection (b) of 35 U.S.C. § 132, effective on May 29, 2000, provides for continued examination of an utility or plant application filed on or after June 8, 1995. See The American Inventors Protection Act of 1999 (AIPA).	Application Number	11/494,056
	Filing Date	July 27, 2006
	First Named Inventor	Kevin Shea
	Group Art Unit	1756
	Examiner Name	Caleen O. Sullivan
	Attorney Docket Number	303.867US3
	Customer No.	21186

This is a Request for Continued Examination (RCE) under 37 CFR § 1.114 of the above-identified application entitled **SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND SURFACE TREATMENT COMPOSITIONS USED THEREFOR.**

Submission required under 37 C.F.R. § 1.114

1. ☐ Consider the amendment(s)/reply under 37 C.F.R. § 1.116 previously filed on .
2. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on .
3. ☒ Amendment Under 37 CFR § 1.116 (16 pages) is enclosed.
4. ☐ New power of attorney (pages) is enclosed.
5. ☒ Information Disclosure Statement is enclosed (2 pages), with:
 - a. Form 1449 (1 pages)
 - b. Copies of IDS Citations (14)
6. ☒ Please charge Deposit Account 19-0743 in the amount of \$810.00 to pay the RCE filing fee required under C.F.R. § 1.17(e).
7. ☒ The Commissioner is hereby authorized to credit overpayments or charge any fees set forth in 37 CFR §§ 1.16 through 1.18 to Deposit Account No. 19-0743.
8. ☐ Petition for Extension of Time in the prior application (1 page) is enclosed along with authorization to charge Deposit Account 19-0743 in the amount of to pay the extension fee.
9. ☐ Others:

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.

By: Mark V. Muller /
Atty: Mark V. Muller
Reg. No. Reg. No. 37,509

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Attn-Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 10th day of October, 2007.

Amy Moriarty
Name

[Signature]
Signature

EXPEDITED PROCEDURE – EXAMINING GROUP 1756

S/N 11/494,056

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Kevin Shea et al.	Examiner:	Caleen O Sullivan
Serial No.:	11/494,056	Group Art Unit:	1756
Filed:	July 27, 2006	Docket No.:	303.867US3
Title:	SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND SURFACE TREATMENT COMPOSITIONS USED THEREFOR		

AMENDMENT & RESPONSE UNDER 37 C.F.R. 1.116

Mail Stop RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In response to the Final Office Action mailed August 17, 2007, please amend the Application as follows, and consider the appended remarks.

IN THE CLAIMS

Please amend the claims as follows.

1. (Currently Amended) A process comprising:
patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:
at least one antireflective coating disposed over the hard mask, selected from [[a]]
the group consisting of a dielectric antireflective coating and a bottom antireflective coating; and
a photo resist layer disposed over the at least one antireflective coating; and
surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate.
2. (Previously Presented) The process of claim 1, wherein surface treating includes rinsing the photo resist with a solution selected from aqueous ammonium hydroxide and hydrogen peroxide solution, aqueous sulfuric acid and citric acid solution, aqueous sulfuric acid and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, ozone with dilute hydrogen fluoride, and combinations thereof.
3. (Currently Amended) The process of claim 1, wherein surface treating includes using a water, ammonium hydroxide and hydrogen peroxide solution in an $H_2O:NH_4OH:H_2O_2$ volume concentration ratio from about 5:1:1 to about 100:3:2, a time range from about 2 minutes to about 45 minutes, and a temperature range from about room temperature to about 70° C.
4. (Currently Amended) The process of claim 1, wherein surface treating includes using a water, ammonium hydroxide and hydrogen peroxide solution in an $H_2O:NH_4OH:H_2O_2$ volume concentration ratio of about 100:3:2, a time range from about 10 minutes to about 20 minutes, and a temperature range from about 30° C to about 60° C.

5. (Currently Amended) ~~A process comprising:~~

~~patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:~~

~~at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating; and~~

~~a photo resist layer disposed over the at least one antireflective coating; and~~

The process of claim 1, wherein surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, ~~wherein surface treating~~ includes using a water, ammonium hydroxide and hydrogen peroxide solution in an H₂O:NH₄OH:H₂O₂ volume concentration ratio of about 100:3:2, and a temperature of about 55° C.

6. (Canceled)

7. (Currently Amended) The process of claim 5, wherein surface treating includes a surface treating time of greater than about 5 minutes to about ~~[[10]]~~ 30 minutes.

8. (Canceled)

9. (Canceled)

10. (Currently Amended) ~~A process comprising:~~

~~patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:~~

~~at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating;~~
and

~~a photo resist layer disposed over the at least one antireflective coating; and~~

The process of claim 1, wherein surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, ~~wherein surface treating~~ includes using an aqueous sulfuric acid and citric acid solution for a time of about 10 minutes, and a temperature of about 55° C.

11. (Currently Amended) The process of claim 10, wherein surface treating includes using a water, sulfuric acid and citric acid solution in an H₂O:H₂SO₄:C₆H₄O₇ volume concentration ratio of about 100:3:2.

12. (Canceled)

13. (Original) A process comprising:
patterning a hard mask with a patterned photo resist layer; and
surface treating the substrate to remove residual photo resist at a first etch rate under conditions that are selective to etch the hard mask at a second etch rate that is lower than the photo resist first etch rate.

14. (Previously Presented) The process of claim 13, wherein surface treating includes rinsing the photo resist with a solution selected from a mixture of at least one of aqueous ammonium hydroxide and hydrogen peroxide solution, aqueous sulfuric acid and citric acid solution, aqueous sulfuric acid and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, ozone with dilute hydrogen fluoride, fluorozone and piranha solution.

15. (Currently Amended) The process of claim 14, wherein surface treating includes using a water, ammonium hydroxide and hydrogen peroxide solution in an $H_2O:NH_4OH:H_2O_2$ volume concentration ratio from about 5:1:1 to about 100:3:2, a time range from about 2 minutes to about 45 minutes, and a temperature range from about room temperature to about 70° C.

16. (Canceled)

17. (Currently Amended) The process of claim 13, wherein the first etch rate is at least about a hundred times faster than the second etch rate, and the photo resist includes at least one antireflective coating.

18. (Canceled)

19. (Original) The process of claim 13, wherein the hard mask comprises carbon.

20. (Canceled)

21. (Currently Amended) The process of claim ~~[[18]]~~ 17, wherein the dielectric antireflective coating is formed above the hard mask, ~~the~~ a bottom antireflective coating is formed above the antireflective coating, and the photo resist layer is formed above the bottom antireflective coating.

22. (Canceled)

23. (Original) The process of claim 13, wherein the patterned photo resist layer is used as one of a plasma etch, a wet chemical etch and a dry develop mask for patterning the hard mask.

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24. (Currently Amended) ~~A process comprising:~~

~~patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:~~

~~at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating; and~~

~~a photoresist layer disposed over the at least one antireflective coating; and~~

The process of claim 1, wherein surface treating the substrate to remove residual resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, ~~wherein surface treating~~ includes using an ozone-containing solution.

25. (Previously Presented) The process of claim 24, wherein surface treating includes using the ozone-containing solution and at least one of aqueous sulfuric acid and citric acid solution, aqueous sulfuric and hydrogen peroxide solution, ozone with dilute ammonium hydroxide, and ozone with dilute hydrogen fluoride.

26. (Currently Amended) ~~A process comprising:~~

~~patterning an amorphous carbon hard mask with a resist stack over a substrate, the resist stack including:~~

~~at least one antireflective coating disposed over the hard mask, selected from a group consisting of a dielectric antireflective coating and a bottom antireflective coating; and~~

~~a photoresist layer disposed over the at least one antireflective coating; and~~

The process of claim 1, wherein surface treating the substrate to remove residual resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate, ~~wherein surface treating~~ includes using a sulfuric acid-containing solution.

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27. (Original) The process of claim 26, wherein surface treating includes using the sulfuric acid-containing solution and at least one of aqueous citric acid, aqueous oxaloacetic acid, aqueous acetic acid, and an acetic functional group aqueous acid.

28. - .34 (Canceled)

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REMARKS

This communication responds to the Office Action mailed on August 17, 2007. Claims 1, 3-5, 7, 10-11, 15, 17, 21, 24 and 26 are amended, claims 6, 8, 9, 12, 16, 18, 22 and 28-34 are canceled, and no claims are added; as a result, claims 1-5, 7, 10-11, 13-15, 17, 19-21 and 23-27 are now pending in this Application.

Double Patenting Rejection

Claims 13-16, 19-20 and 23-24 were rejected under a non-statutory double patenting rejection, specifically over claims 1-11, 24-34 and 39-42 of copending Application No. 10/788,889 (U.S. 2005/0191584). Applicant does not admit that claims are obvious in view of copending Application No. 10/788,889 (U.S. 2005/0191584).

Independent claim 13 is held to not be obvious over the cited copending application for the following reasons. Present independent claim 13 recites *patterning a hard mask with a patterned photo resist layer; and surface treating the substrate to remove residual photo resist at a first etch rate under conditions that are selective to etch the hard mask at a second etch rate that is lower than the photo resist first etch rate*. Claim 1 of the cited copending application recites a “carbon-containing hard mask”, and removing residual photo resist “selective to the hard mask and to the substrate”, and the present claim is held to be non obvious at least in the substantial difference of the recited etching rate of the substrate due to the limitation of the hard mask being formed of amorphous carbon in the copending application.

The copending application claims are concerned with amorphous carbon hard masks and with concentration ratios of water, ammonium hydroxide, hydrogen peroxide, sulfuric acid, citric acid, and fluorozone, while in the present claims, the use of carbon is recited in dependent claims 19 and 20, which depend upon independent claim 13. Independent claim 13, from which the other claims depend, does not recite concentration ratios. Independent claim 13 relates to surface treatment conditions that provide a differential etch rate, and are not believed to be obvious over the cited claims of the copending application. However, a Terminal Disclaimer in compliance with 37 CFR 1.321(b)(iv) may be considered to obviate these rejections when the present claims are otherwise held to be allowable.

§112 Rejection of the Claims

Claims 3-12 and 15-16 were rejected under 35 U.S.C. § 112, first paragraph, as lacking adequate description. Specifically, “concentration ratios” for the surface treating solutions. Applicant respectfully traverses this rejection.

Applicant respectfully submits that the specification clearly indicates the type of concentration ratio used, such as on page 9, line 30, where it is noted that the “presence by volume” of an aqueous solution is the ratio indicated, and on page 10, lines 4 and 6, page 12, line 27. Applicant agrees with the Examiner’s assumption that volume ratios are indicated by the specification. Applicant respectfully submits that the description is adequate for one of ordinary skill in the art to practice the invention without undue experimentation.

Applicant respectfully submits that the outstanding Office Action has failed to establish a *prima facie* case of lack of written description under § 112, since it does not demonstrate the required elements (1) the application does not reasonably describe or convey the concepts (2) to one of ordinary skill in the art (3) at the time of filing the patent application (4) of the claimed invention. In view of the above noted locations in the specification where the concentration ratio is stated to be a volume concentration ratio, Applicant respectfully submits that the claim language is proper under 35 USC § 112, first paragraph, and therefore requests that this rejection under the first paragraph of 35 U.S.C. § 112 be reconsidered and withdrawn.

Claims 1, 3-12, 15-16, 24 and 26 were rejected under 35 U.S.C. § 112, second paragraph, for indefiniteness. Specifically, with respect to the use of “concentration ratio” (for the same reasons given above). Applicant respectfully submits that the claim language is proper and supported by the specification, as discussed above. Claims 11 and 13 have been amended herein to clarify that a “volume concentration” is intended, and not for reasons related to patentability. The second portion of the rejection specifically objects to improper Markush language, such that “... selected from a group consisting of ...” should be amended to read the group. The claims have been so amended herein, and the Applicant expresses appreciation to the Examiner for bringing this aspect of the claims to the attention of the Applicant. The Applicant submits that

the claims are now in proper condition for allowance, being fully supported by the specification. Therefore, it is respectfully requested that this rejection be reconsidered and withdrawn.

§103 Rejection of the Claims

Claims 1-3, 13-21 and 23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu (U.S. 7,064,078) in view of Szwejkowski (U.S. 5,147,499). Applicant respectfully traverses this rejection. Applicant notes that claims 16, 18 and 20 are canceled herein.

Liu discloses a first photoresist mask 106 used to etch a first pattern 108 in an amorphous carbon hard mask 104, removing the first photoresist, such that no photoresist remains on the pattern (Figure 2C, col. 5, line 23). Thus, Liu can not suggest a surface treatment to remove residual photo resist since none remains by Liu's teaching.

A second photoresist mask 110 is used to etch a second (i.e., a different) pattern 112 on the hard mask 114, and the second photoresist is removed leaving no photoresist on the patterned hard mask 104 (col. 5, line 26). Again, Liu can not suggest a surface treatment to remove residual photoresist, because none remains. Liu then etches the combined pattern of the first and the second photoresist layers, each of which has been used to etch the hard mask 104, into the substrate 102 below the hard mask.

Liu does not suggest the use of a resist stack, or even suggest a problem with residual photoresist material remaining after the removal of the photoresist. The present application describes how to remove photoresist from a *dielectric antireflective coating and a bottom antireflective coating* at the same time as the hard mask and substrate, as shown in figures 1A-1D and discussed on page 5, lines 17-26. Liu merely discloses removal of photoresist from a hard mask, which is well known to one of ordinary skill to be a different situation. The reference discloses a different arrangement of materials for a different problem, and thus Liu is inappropriate for use as a reference on which an obviousness rejection is based.

Szwejkowski describes removing a silicon and oxide containing sidewall material 26, which is a polymer inadvertently formed during the anisotropic etch forming the polysilicon 20 into polysilicon line 28. The sidewall material 26 is formed of silicon and oxides, and is not suggested to be a residual portion of the photoresist 32 (col. 1, lines 32-42, col. 2, lines 4-11).

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The sidewall material 26 is conventionally removed using hydrofluoric acid (col. 2, lines 29-38; col. 3, lines 5-11). Szwejkowski also notes that the sidewall material is “not purely polysilicon” (see col. 3, line 8) and is not a photoresist or an organic material.

Applicant therefore submits that Szwejkowski also does not suggest removing a photoresist, or that the silicon and oxide film 26 is somehow related to residual photoresist. Szwejkowski’s methods, including HF etching, are directed towards dielectric etching. The cited reference has a different arrangement of materials, does not suggest the use of a resist stack, and the suggested method would have no affect on a residual photoresist region, as the present Application discloses. The suggested method is inoperable to address the problem described by the present Application, and thus Szwejkowski is an inappropriate reference on which to base an obviousness rejection.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*patterning an amorphous carbon hard mask with a resist stack ... and surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask, the at least one antireflective coating, and the substrate...*”, as recited in amended independent claim 1, from which claims 2 and 3 depend. Since neither cited reference contains any suggestion of a photoresist stack, or residual resist, or of removing the residue from the resist stack, it would be impossible for the suggested combination to include these features.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*surface treating the substrate to remove residual photo resist at a first etch rate under conditions that are selective to etch the hard mask at a second etch rate that is lower than the photo resist first etch rate...*”, as recited in independent claim 13. Since neither cited reference contains any suggestion of any form of residual resist, or of removing a residue, it would be impossible for the suggested combination to include these features.

The dependent claims are held to be patentable at least as depending from patentable base claims as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the cited references failing to describe or

suggest at least removing residual photoresist, or the presence of a resist stack, Applicant respectfully requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Claim 22 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu (U.S. 7,064,078) in view of Szwejkowski (U.S. 5,147,499) as applied to claims 1-3, 13-21 and 23 in paragraph 7 above, and further in view of Tsai (U.S. 6,720,132). Applicant notes that claim 22 is canceled herein, and consequently this rejection is moot.

Claims 4 and 16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu (U.S. 7,064,078) in view of Szwejkowski (U.S. 5,147,499) as applied to claims 1-3, 13-21 and 23 in paragraph 7 above, and further in view of Chen (U.S. Publication No. 2005/0026435 A1). Applicant respectfully traverses this rejection. Claim 16 is canceled herein.

The cited references of Liu and Szwejkowski have been discussed above with respect to the previous rejections. Chen shows that solutions of ammonium hydroxide and peroxide are known in the art to be used for cleaning. Chen does not cure the failure of the suggested combination to suggest resist stacks, or resist residues, or removing resist residues, and thus the suggested combination fails to disclose all of the elements recited by the present claims.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*patterning an amorphous carbon hard mask with a resist stack ... surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask...*”, as recited in amended independent claim 1, from which claim 4 depends. Since the cited references do not suggest a photoresist stack, or a residual resist, or removing the residue, then the suggested combination does not contain the above features.

In view of the failure of the references to describe or suggest at least removing residual photoresist, or a resist stack, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Serial Number: 11/494,056

Filing Date: July 27, 2006

Title: SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND SURFACE TREATMENT COMPOSITIONS USED THEREFOR

Claims 5-9 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu (U.S. 7,064,078) in view of Szwejkowski (U.S. 5,147,499) and further in view of Chen (U.S. Publication No. 2005/0026435 A1). Applicant respectfully traverses this rejection.

Applicant notes that claims 6, 8 and 9 are canceled herein. Szwejkowski describes removing a silicon and oxide containing sidewall material 26, which is a polymer inadvertently formed during the anisotropic etch forming the polysilicon 20 into polysilicon line 28. The sidewall material 26 is formed of silicon and oxides, and is not suggested to be a residual portion of the photoresist 32 (col. 1, lines 32-42, col. 2, lines 4-11). The sidewall material 26 is conventionally removed using hydrofluoric acid (col. 2, lines 29-38; col. 3, lines 5-11). Szwejkowski also notes that the sidewall material is “not purely polysilicon” (see col. 3, line 8) and is not a photoresist or an organic material.

Chen is used in the outstanding Office Action to show that solutions of ammonium hydroxide and peroxide are known in the art to be used for cleaning. Chen does not cure the failure of the suggested combination to suggest resist stacks, or resist residues, or removing resist residues, and thus the suggested combination fails to disclose all of the elements recited by the present claims.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*patterning an amorphous carbon hard mask with a resist stack ... surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask...*”, as recited in amended independent claim 1, from which claims 5 and 7 depend. Since the cited references do not suggest a photoresist stack, or a residual resist, or removing the residue, then the suggested combination does not contain the above features.

The dependent claims are held to be patentable at least as depending from patentable base claims as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the failure of the references to describe or suggest at least removing residual photoresist, or a resist stack, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Serial Number: 11/494,056

Filing Date: July 27, 2006

Title: SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND SURFACE TREATMENT COMPOSITIONS USED THEREFOR

Claims 24-25 and 28-34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Liu (U.S. 7,064,078) in view of Szwejkowski (U.S. 5,147,499) and further in view of Chen (U.S. Publication No. 2005/0026435 A1). Applicant respectfully traverses this rejection. Applicant notes that claims 28-34 are canceled herein.

Liu discloses removing the first and second photoresist layers on a hard mask with no photoresist remaining on the pattern (Figure 2C, col. 5, lines 23-26). Liu does not suggest a surface treatment to remove residual photo resist since no photoresist remains. Liu does not suggest the use of a resist stack, or a problem with residual photoresist material remaining after the removal of the photoresist. Liu discloses removal of a photoresist from a hard mask.

Szwejkowski describes removing a polymer 26 formed during the anisotropic etch forming the polysilicon 20, formed of silicon and oxides, and not a residual photoresist 32 (col. 1, lines 32-42, col. 2, lines 4-11). The sidewall material 26 is removed using hydrofluoric acid (col. 2, lines 29-38; col. 3, lines 5-11).

Chen is used in the Office Action to show that solutions of ammonium hydroxide and peroxide are known in the art to be used for cleaning. Chen does not cure the failure of the suggested combination to suggest resist stacks, or resist residues, or removing resist residues, and thus the suggested combination fails to disclose all of the elements recited by the present claims.

Applicant respectfully submits that the suggested combination of references fails to describe or suggest at least the claimed features of “...*patterning an amorphous carbon hard mask with a resist stack ... surface treating the substrate to remove residual photo resist under conditions that are selective to leaving the hard mask ...*”, as recited in amended independent claim 1, from which claims 24 and 25 depend. The cited references do not suggest a photoresist stack, or a residual resist, or removing the residue, as discussed above with reference to the previous rejections, and thus the suggested combination does not contain the above features.

The dependent claims are held to be patentable at least as depending from patentable base claims as shown above, since any claim depending from a nonobvious independent claim is also nonobvious. See M.P.E.P. § 2143.03. In view of the failure of the references to describe or suggest at least removing residual photoresist, or a resist stack, Applicant requests this rejection under 35 U.S.C. § 103(a) be reconsidered and withdrawn.

Serial Number: 11/494,056

Filing Date: July 27, 2006

Title: SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND SURFACE TREATMENT COMPOSITIONS USED THEREFOR

RESERVATION OF RIGHTS

In the interest of clarity and brevity, Applicant may not have addressed every assertion made in the Office Action. Applicant's silence regarding any such assertion does not constitute any admission or acquiescence. Applicant reserves all rights not exercised in connection with this response, such as the right to challenge or rebut any tacit or explicit characterization of any reference or of any of the present claims, the right to challenge or rebut any asserted factual or legal basis of any of the rejections, the right to swear behind any cited reference such as provided under 37 C.F.R. § 1.131 or otherwise, or the right to assert co-ownership of any cited reference. Applicant does not admit that any of the cited references or any other references of record are relevant to the present claims, or that they constitute prior art. To the extent that any rejection or assertion is based upon the Examiner's personal knowledge, rather than any objective evidence of record as manifested by a cited prior art reference, Applicant timely objects to such reliance on Official Notice, and reserves all rights to request that the Examiner provide a reference or affidavit in support of such assertion, as required by MPEP § 2144.03. Applicant reserves all rights to pursue any cancelled claims in a subsequent patent application claiming the benefit of priority of the present patent application, and to request rejoinder of any withdrawn claim, as required by MPEP § 821.04.

Serial Number: 11/494,056

Filing Date: July 27, 2006

Title: SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND SURFACE TREATMENT COMPOSITIONS USED THEREFOR

CONCLUSION

Applicants respectfully submit that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicants' attorney at (210) 308-5677 to facilitate prosecution of this Application. If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(210) 308-5677

Date October 10, 2007

By /

Mark V. Muller

Mark V. Muller
Reg. No. 37,509

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Attn-Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this 10th day of October, 2007.

Amy Moriarty
Name

[Signature]
Signature



S/N 11/494,056

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Kevin Shea et al.	Examiner:	Caleen O Sullivan
Serial No.:	11/494,056	Group Art Unit:	1756
Filed:	July 27, 2006	Docket:	303.867US3
Title:	SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND SURFACE TREATMENT COMPOSITIONS USED THEREFOR		

INFORMATION DISCLOSURE STATEMENT

MS RCE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In compliance with the duty imposed by 37 C.F.R. § 1.56, and in accordance with 37 C.F.R. §§ 1.97 *et. seq.*, the enclosed materials are brought to the attention of the Examiner for consideration in connection with the above-identified patent application. Applicants respectfully request that this Information Disclosure Statement be entered and the documents listed on the attached Form 1449 be considered by the Examiner and made of record. Pursuant to the provisions of MPEP 609, Applicants request that a copy of the 1449 form, initialed as being considered by the Examiner, be returned to the Applicants with the next official communication.

Pursuant to 37 C.F.R. §1.97(b), it is believed that no fee or statement is required with the Information Disclosure Statement.

Pursuant to 37 C.F.R. 1.98(a)(2), Applicant believes that copies of cited U.S. Patents and Published Applications, and Non-Published Applications identifiable by USPTO Serial Number, are no longer required to be provided to the Office. Notification of this change to this effect was provided in the United States Patent and Trademark Office OG Notices dated October 12, 2004 and October 19, 2004. Thus, Applicant has not included copies of any US Patents or US Patent Applications identifiable by serial number that may be cited with this submission. Should the Office require copies to be provided, Applicant respectfully requests that notice of such requirement be directed to Applicant's below-signed representative. Applicant acknowledges the requirement to submit copies of foreign patent documents and non-patent literature in accordance with 37 C.F.R. 1.98(a)(2).

INFORMATION DISCLOSURE STATEMENT

Serial No :11/494,056

Filing Date: July 27, 2006

Title: SURFACE TREATMENT OF A DRY-DEVELOPED HARD MASK AND SURFACE TREATMENT COMPOSITIONS USED THEREFOR

Page 2
Dkt: 303.867US3

The Examiner is invited to contact the Applicants' Representative at the below-listed telephone number if there are any questions regarding this communication.

Respectfully submitted,

SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
612-373-6900

Date October 10, 2007

By /

Mark V. Muller

Mark V. Muller

Reg. No. 37,509

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: MS RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 10th day of October 2007.

Name

Amy Moriarty

Signature

[Signature]



PTO/SB/06A(10-01)
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449A/PTO
**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Use as many sheets as necessary)

Complete if Known

Application Number	11/494,056
Filing Date	July 27, 2006
First Named Inventor	Shea, Kevin
Group Art Unit	1756
Examiner Name	Sullivan, Caleen

Sheet 1 of 1

Attorney Docket No: 303.867US3

US PATENT DOCUMENTS

Examiner Initial *	USP Document Number	Publication Date	Name of Patentee or Applicant of cited Document	Filing Date If Appropriate
	US-20070163997A1	07/19/2007	Shea, K.	03/22/2007
	US-20070178705A1	08/02/2007	Shea, K.	03/22/2007

OTHER DOCUMENTS -- NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No ¹	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
		"Application No. 10/788,889 (Atty Ref No 303.867US1) Non-Final Office Action mailed 12/29/2006", (12/29/2006),17 pages	
		"Application No. 10/788,889 (Atty Ref No 303.867US1) Response filed 06/28/2007 to Final Office Action mailed 05/05/2007", (06/28/2007),15 pages	
		"Application No. 10/788,889 (Atty Ref No 303.867US1) Response filed 3/7/2007 to Non-Final Office Action mailed 12/29/2006", (03/07/2007),23 pages	
		"Application No. 10/788,889 (Atty Ref No. 303.867US1) Final Office Action mailed 5/02/2007", (05/02/2007),14 pages	
		"Application No. 11/168,023 (Atty Ref No 303.898US1) Advisory Action mailed 3/30/2007", (03/30/2007),3 pages	
		"Application No. 11/168,023 (Atty Ref No 303.898US1) Final Office Action mailed 1/25/2007", (01/25/2007),14 pages	
		"Application No. 11/168,023 (Atty Ref No 303.898US1) Non-Final Office Action mailed 6/18/2007", (06/18/2007),14 pages	
		"Application No. 11/168,023 (Atty Ref No 303.898US1) Non-Final Office action mailed 9/14/2006", (09/14/2006),15 pages	
		"Application No. 11/168,023 (Atty Ref No 303.898US1) Response filed 12/14/2006 to Non-Final Office Action mailed 9/14/2006", (12/14/2006),11 pages	
		"Application No. 11/168,023 (Atty Ref No 303.898US1) Response filed 3/05/2007 to Final Office Action mailed 1/25/2007", (03/05/2007),13 pages	
		"Application No. 11/168,023 (Atty Ref No 303.898US1) Response filed 4/25/2007 to Advisory Action mailed 3/30/2007", (04/25/2007),14 pages	
		"Application No. 11/168,023 (Atty Ref No. 303.898US1) Response filed 9/18/2007 to Non-Final Office Action mailed 06/18/2007", (09/18/2007),14	
		"Non-Final Office Action Mailed 08-17-2007 in Serial No. 10/788889 (Atty. Ref. 303.867US1), OARN,13	
		"Restriction Requirement Mailed 09-17-2007 in Serial No. 11/494666 (Atty. Ref. 303.867US2), RERR,7	

EXAMINER

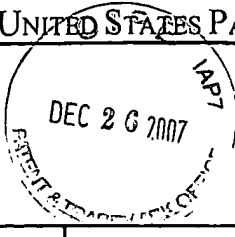
DATE CONSIDERED

Substitute Disclosure Statement Form (PTO-1449)

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional) 2 Applicant is to place a check mark here if English language Translation is attached



UNITED STATES PATENT AND TRADEMARK OFFICE



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/494,666	07/27/2006	Kevin Shea	303.867US2	2151
7590 09/17/2007 Schwegman, Lundberg, Woessner & Kluth, P.A. Attn: Daniel J. Kluth P.O. Box 2938 Minneapolis, MN 55402			EXAMINER LE, HOA VAN	
			ART UNIT 1752	PAPER NUMBER
			MAIL DATE 09/17/2007	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

RESTRICTION REQUIREMENT
FILE DIVISIONAL APPLN?

RESTRICTION REQUIREMENT
FILE DIVISIONAL APPLN?

INTELLEDATE
SEP 17 2007
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Coded [initials] Verified

Schwegman Lundberg
& Woessner P.A.
SEP 17 2007
RECEIVED

Office Action Summary

Application No.

11/494,666

Applicant(s)

SHEA ET AL

Examiner

Hoa V. Le

Art Unit

1752

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 1 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 July 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) 1 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☐ Claim(s) _____ is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☒ Claim(s) 1-26 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

This is in response to Papers filed 18 July 2007.

I. Applicants voluntarily election the invention of Group I, claims 1-9 being acknowledged. The arguments will be addressed in the next Office action when applicants provide a proper, timely and complete election of species together with its argument. Then all of them will be (1) considered for their connection and/or logic and (2) addressed both of them at the same time.

II. Applicants fail to make election of species as set forth on the record. It is repeated about the same as followed:

Claims [1-26] are generic to the following disclosed patentably distinct species: **There are many possible sets of alternated and/or combined chemical compositions with respect to numbers of chemical ingredients, their amounts (proportions of the amounts), such as no specific amount, majority proportion, minority proportion, plurality proportions, first minority proportion, second minority proportion, no specific proportion of both of the first minority proportion and the secondary minority proportion and specified proportion of the first minority proportion as compared to that of the secondary minority proportion.**

The species are independent or distinct because as disclosed the different species have mutually exclusive characteristics for each identified species. In addition, these species are not obvious variants of each other based on the current record.

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Applicant is required under 35 U.S.C. 121 to elect a single disclosed set of combined species by selecting and electing (1) specifying and identifying numbers of the elected proportions, such as to elect one of (i) no specific proportion, (ii) one specific proportion, (iii) two specific proportions, (iiii) three specific proportions and (iiiii) more than three specific proportions (2) each of all chemical ingredients being used in each of the elected proportions and (3) an amount of each of all of the chemical ingredients in each of all of the elected proportions for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable for an initial search processing step, such as: no specific portion as that in claim 1, two proportions as that in claim 20, simple plurality portions as that in claim 10, complex portions as that in claim 14 for examples.

There is an examination and search burden for these patentably distinct species due to their mutually exclusive characteristics. The species require a different field of search (e.g., searching different classes/subclasses or electronic resources, or employing different search queries); and/or the prior art applicable to one species would not likely be applicable to another species; and/or the species are likely to raise different non-prior art issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species to be examined even though the requirement may be traversed (37 CFR 1.143) and (ii) identification of the claims encompassing the elected species, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election of the species may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species.

Should applicant traverse on the ground that the species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

However, applicants may disagree and state on and for the record that the species in the elected invention of Group I, claims 1-9 are not patentably different

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or distinct. Therefore, no separate or additional consideration or search is requested or required.

The election of an invention or species may be made with or without traverse. To reserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the restriction requirement, the election shall be treated as an election without traverse.

Should applicant traverse on the ground that the inventions or species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the inventions or species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C.103(a) of the other invention.”

III. There has been on the record that:

“Other issues have not been considered until (1) all of the requirements are met and (2) proper and timely elections are made and resolved.”

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VI. No search or examination is made yet since the election made and filed on 18 July 2007 is incomplete and not yet resolved with respect to the election of species. No species election is made as set forth on the record.

IV. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hoa V. Le whose telephone number is 571-272-1332.

The examiner can normally be reached from 6:30 AM to 4:30 PM on Monday through Thursday and about the same time of most Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cynthia Kelly can be reached on 571-272-1526.

Applicants may file a paper by (1) fax with a central facsimile receiving number 571-273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private

Application/Control Number: 11/494,666

Page 6

Art Unit: 1752

PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Hoa V. Le
Primary Examiner
Art Unit 1752

HVL
18 June 2007

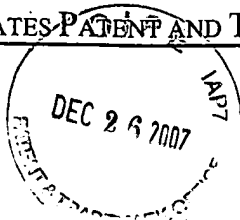
NOA VOTE
PRIMARY EXAMINER
Hoa Van Le



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
11/494,666	07/27/2006	Kevin Shea	P 303.867US2	2151

7590 10/24/2007
Schwegman, Lundberg, Woessner & Kluth, P.A.
Attn: Daniel J. Kluth
P.O. Box 2938
Minneapolis, MN 55402

EXAMINER

LE, HOA VAN

ART UNIT	PAPER NUMBER
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1795

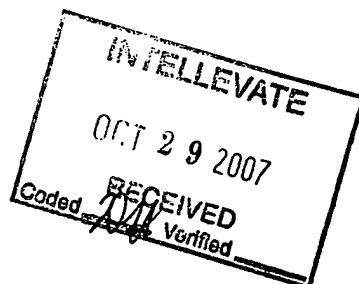
MAIL DATE	DELIVERY MODE
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10/24/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.



Schwegman Lundberg
& Woessner P.A.

OCT 29 2007

RECEIVED

Office Action Summary	Application No. 11/494,666	Applicant(s) SHEA ET AL.	
	Examiner Hoa V. Le	Art Unit 1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 July 2007 and 08 October 2007.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-9 is/are pending in the application.
- 4a) Of the above claim(s) 3-9 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-2 as elected is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☒ Claim(s) 3-9 are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

This is in response to Election filed on 18 July and 08 October 2007.

I. The record shows that:

"Applicant in the response elected, with traverse, Group I, claims 1-9, stating a belief that claim 1 is generic to claims 1-26. Applicant also stated its belief that species I, II and III were not obvious variants of each other. However, in view of the Examiner's persuasive remarks offered in the Restriction Requirement subsequently mailed to the Applicant on September 17, 2007, the Applicant now accepts the Examiner's restriction requirement without traverse, and elects prosecution of Group I. Claims 10-26 are hereby canceled without prejudice or disclaimer.

In response to the request to elect a species having fewer combinations of chemical ingredients and proportions, Applicant elects to prosecute the species having the combination of chemical compounds of claims 1 and 2, and withdraws claims 3-9 from consideration without prejudice. Claim 1 recites no specific proportions of water, ammonium hydroxide and hydrogen peroxide, and specifies that the composition is *selective to amorphous carbon*. Claim 2 adds the feature of a smaller amount of at least one compound from among aqueous sulfuric acid and citric acid solution, or aqueous sulfuric and hydrogen peroxide solution, or ozone with dilute ammonium hydroxide, or ozone with dilute hydrogen fluoride. No specific proportions of these added compounds is recited. Thus, the set of combinations is in accordance with item (i) having no specific proportions, and reducing the number of combinations."

II. Upon the allowance of a generic claim, **especially claim 1**, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141. If claims are added after the election, applicant must indicate which are readable upon the elected species. MPEP § 809.02(a).

III. Considerations and searches of the claims:

(1) The language: "wherein the...amorphous carbon" is the using steps (1) **obtaining a photoresist material having thereon a carbon-containing photoresist layer, (2) performing a dry-development on the photoresist with the result of having amorphous carbon residues on the photoresist and (3) a claimed composition is applying on the photoresist having amorphous carbon residues to be effectively removed the amorphous carbon residues.** Therefore, the composition, per se, such as from "water to hydrogen peroxide" is not considered, searched and examined by itself. Therefore, an enforcement should and must be all of the embodiments of considerations, searches and examined.

(2) Applicants recognize that the claim composition, per se, could not be able to be patented by itself. Therefore, applicants have to relied on the secondary embodiment with respect to "wherein the...amorphous carbon" of the using steps. Applicants should disagree, urge and/or show other wise on and for the record that the claimed composition, per se, is patentable in the next Office action in order for it to be considered timely. However, the using steps have less value in a composition claim than those in a method claim in the parent application no. 10/788889.

(3) The language "aqueous sulfuric acid...hydrogen fluoride" is a product-by-process. It is ordinary has no value until applicants convincingly provide an

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evidence that (i) the processing steps of making the claimed product are, in fact, made a distinct product chemical structure and (ii) the distinct product chemical structure is, in fact, provided an unusual or unexpected result over each of all known or obviously known product in the art. An allowed claim or patent would have no value when someone shows that (i) the processing steps of making the claimed product are made an obvious product as broadly claimed or (ii) the made product is provided an obvious result as broadly claimed.

IV. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The elected claims 1-2 are rejected under 35 U.S.C. 103(a) as being unpatentable over Verhaverbeke et al (6,491,763).

Verhaverbeke et al disclose, teach and suggest analogue photoresist treatment to remove an unwanted organic contaminant using a chemical composition comprising a small and sufficient amount of ozone, a small and sufficient amount of sulfuric acid, a small and sufficient amount of hydrogen peroxide, a small and sufficient amount of ammonium hydroxide, a small and

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sufficient amount of hydrofluoric acid and a large and sufficient amount of water.

Please see the whole disclosure of the applied reference, especially at least col.1:57-62, 5:47-57, 6:5-8, 27-31, 7:47-49, 8:1-6, 9-12, 11:48-65, 12:21-22. The language: "...amorphous carbon" is a property with respect to an ability and/or capability and is inherent. Since an allowability of the claims is on the inherent property of an ability and or capability, applicants are requested and required to convincingly show an evidence to the contrary set clearly pointed out and set forth on the record. An allowed claim or patent would have no value when someone shows that the applied composition have at least the same or obviously about the same ability, capability or result as the instantly claimed composition with respect to chemical ingredients in the broad claim 1. A showing should be provide in the next response to this Office action in order for it to be considered timely. In the absence of an evidence to the contrary, the claims are reasonably found to be rendered prima face obvious by Verhaverbeke et al.

V. 5,908,509 6703,317 6,759,263 6,840,250 2002/0144709 20030121537 20030181055 2003/0219912 20030175523 20070070803 are cited to show the state of the art but may later applied when an amendment is made.

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VI. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hoa V. Le whose telephone number is 571-272-1332.

The examiner can normally be reached from 6:30 AM to 4:30 PM on Monday through Thursday and about the same time of most Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cynthia Kelly can be reached on 571-272-1526.

Applicants may file a paper by (1) fax with a central facsimile receiving number 571-273-8300. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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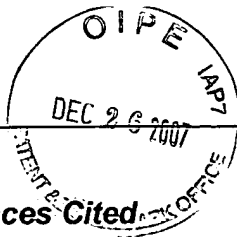
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Hoa V. Le
Primary Examiner
Art Unit 1752

HVL
22 October 2007

HOA VAN LE
PRIMARY EXAMINER

Hoa Van Le

**Notice of References Cited**

Application/Control No.

11/494,666

Applicant(s)/Patent Under
Reexamination
SHEA ET AL.

Examiner

Hoa V. Le

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Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,908,509	06-1999	Olesen et al.	134/1.3
*	B	US-6,703,317	03-2004	Cheng et al.	438/716
*	C	US-6,759,263	07-2004	Ying et al.	438/48
*	D	US-6,840,250	01-2005	Kashkoush et al.	134/1.3
*	E	US-2002/0144709	10-2002	Kashkoush et al.	134/1.3
*	F	US-2003/0121537	07-2003	Dunn, L. Brian	134/182
*	G	US-2003/0181055	09-2003	Wu et al.	438/709
*	H	US-2003/0219912	11-2003	Chen et al.	438/3
*	I	US-2003/0175523	09-2003	Moya, Wilson	428/421
*	J	US-2007/0070803	03-2007	Urquhart, Karl J.	366/152.4
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.